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INTEGRATED MAINTENANCE AND LOGISTICS SOLDIER SYSTEM

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14. ABSTRACT <p>This report describes the application of the Integrated Maintenance and Logistics Soldier System (IMLSS) in support of advanced maintenance and logistics activities for the US Army. The Boeing Company accomplished the effort as part of the Army's Advanced Concepts and Technology (ACT) II program in cooperation with the US Army Soldier and Biological Chemical Command (SBCCOM) - Natick Soldier Center (NSC), and the Combat Service Support Battle Lab, Ft. Lee, VA. The IMLSS wearable information system for vehicle/weapon system integrated maintenance and logistics (IML) activities combines state-of-the-art computing hardware technology (which allows untethered and wireless system interfaces) with enhanced software graphical user interfaces (GUIs), the Integrated Diagnostics & Repair Support System (IDRIS) software, and state-of-the-art heads-up display technology for ease of integrated system diagnostics, fault detection and fault isolation to the system Line Replaceable Unit (LRU). After fault detection and isolation, the user builds vehicle/weapon system maintenance work order and parts requisition forms with either pointer or "hands-free" commanding utilizing application specific software running in conjunction with standard on-board Electronic Technical Manuals (ETMs).</p>					
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Preface

This report describes the application of the Integrated Maintenance and Logistics Soldier System (IMLSS) in support of advanced maintenance and logistics activities for the US Army. The Boeing Company accomplished the effort as part of the Army's Advanced Concepts and Technology (ACT) II program, ref.: 97CSS-018 contract DAAK60-97-C-9212. The Government personnel were from the US Army Soldier and Biological Chemical Command, (SBCCOM), Soldier Systems Center, Natick, MA, and the Combat Service Support Battle Lab, Ft. Lee, VA.

INTEGRATED MAINTENANCE AND LOGISTICS SOLDIER SYSTEM

1. Introduction

This Final Report is submitted in compliance with contract DAAK60-97-C-9212 to complete the data deliverables for the Advanced Concept Technology (ACT) II / Integrated Maintenance and Logistics Soldier System (IMLSS) Program, Combat Services Support (CSS) Tele-Maintenance Program 97CSS-018. This report depicts significant events and milestones of the ACT II / IMLSS Program that led to a final Concept Demonstration of weapon system tele-maintenance at the National Training Center, Ft. Irwin, CA. Final hardware delivery for this contract is scheduled for June 1998.

1.1 Background

From contract start, the ACT II / IMLSS Program focused on providing the customer with an integral wearable concept system in order to perform advanced electronic maintenance and logistics on Army vehicles and weapon systems. Proof-of-concept of this system would be in an actual field demonstration with a Paladin M109A6 self-propelled Howitzer. This system would be designed such that the maintainer in the shop and in the field could perform his/her duties much easier and faster than by the existing paper technical manual and lengthy work order submittal system. As a minimum, the new system would allow the maintainer to: interrogate the Paladin's MIL-STD-1553 data bus to locate an interjected faulty component, use Army issued electronic technical manuals (ETMs) to locate the remove and replace procedures for the component, navigate within the ETM repair parts and standard tools list (RPSTL) to locate the component's part number and description, and finally, input the component data into an electronic standard Army work order (WO) and transmit the WO via the Army single channel ground and airborne radio set (SINCGARS). In order to meet these challenging requirements, the team set out to implement an Integrated Maintenance and Logistics Soldier System (IMLSS) that at a minimum would include hosting Army ETMs, voice recognition, a wireless local area network (LAN), and interface to the SINCGARS. As a design goal, the team also set out to provide an interface concept that would allow the Army to connect to any vehicle/weapon system in inventory for performing maintenance and logistics functions.

2. Research and Analysis

2.1 Wireless Connectivity for Maintenance Mobility

Much research at the front-end of the project was necessary to meet the challenging objective of producing a wireless radio frequency (RF) local area network (LAN) interface for the tele-maintenance concept. This research produced a commercial off-the-shelf (COTS) "black-box" that eventually became a key integral component of the IMLSS. This Maintenance and Logistics Interface Box (MALIB) became the interface box for the Paladin weapon system that allowed hard-wired 1553 integration and wireless connectivity to the wearable maintenance vest. But, in a broader context, the MALIB

became a means to truly demonstrate the team goal of IMLSS versatility with regard to integrated maintenance and logistics (IML) for any vehicle/weapon system in Army inventory. The final configuration of the MALIB for field concept demonstration was as follows: inside a rugged housing, 1) a 486 single board computer, 2) a 75MHz processor with 16MB random access memory (RAM), 3) a hard drive module with a 340MB Personal Computer (PC) hard drive, 4) 2 - 2 slot PCMCIA modules, 5) a dual fan module, 6) a power supply module, and 7) a J1708 module. The PCMCIA modules housed a 1553 PC card and a wireless LAN. The J1708 module showed versatility of the IMLSS to connect with various systems, i.e. the Heavy Equipment Transporter System (HETS), however, this capability was not required to be used or demonstrated under this ACT II.

The software that was hosted on the MALIB to perform the various IML functions was: 1) the IMLSS executable for accessing the various maintenance and logistics graphical interfaces for user navigation, 2) the 1553 executable for the Paladin 1553 Monitor software that monitored the active Paladin 1553 data bus, 3) the wireless LAN drivers for wireless connectivity to the wearable maintenance vest, and 4) the Turbine Engine Diagnostics System (TEDS) executable that demonstrated the versatile capability of the IMLSS by performing IML on an M1 tank. "PC Anywhere" was also hosted on the MALIB to allow the maintainer to visually see what the MALIB was executing since the MALIB did not require an external monitor hook-up.

2.2 Tactical Communications for Electronic Work Orders

Another key component of the IMLSS that provided enhanced capability was the use of the PCMCIA-Tactical Communications Interface Module (P-TCIM) PC card for WO transmission via SINCGARS. A significant amount of research of the market indicated that this particular interface was "in-progress" in the commercial sector, however, far short of a seamless interface for the Windows 95 operating system environment. Therefore, much research and analysis was expended to determine the best design solution to finalize this interface.

3. IMLSS System Design

3.1 P-TCIM

In the early stages of the project, P-TCIM PC cards were obtained that needed conversion from Borland compiled code to Microsoft Visual C++. This conversion effort had not been attempted prior to receipt of these commercially available PC cards, thus the magnitude of this effort was not completely clear. As it turned out, this effort became quite significant and two plans were put in place to keep the IMLSS project moving toward a 3/98-field demonstration.

As a result of several technical meetings with the P-TCIM PC card supplier, it became very clear that it would be much easier to make a firmware change to the P-TCIM PC cards to allow the cards to act as a standard COM1 or COM2 serial port. With the use of a serial PC card in a vacant PCMCIA slot, the SINCGARS connectivity could be made

quite easily. Additionally, a different set of P-TCIM PC cards were obtained from an alternate supplier who had already somewhat bridged the gap from the Borland environment to the Windows 95 environment. With the first set of cards, the firmware changes were made, however, more software development was needed and due to time constraints the decision was made to not pursue this option for demonstration on ACT II.

After several attempts to use the second set of cards in the Maintenance and Repair Support System (MARSS) vests that were to be used for the field demonstration, the cards would not operate properly in the vests and caused the wireless LAN to fail. The end solution and final configuration for the field demonstration integrated the second set of PC cards into a laptop with a wireless LAN that allowed connectivity to the wearable maintenance vest. This laptop and another laptop integrated to the Army SINCGARS for WO file transfer from the wearable maintenance vest. Development continues with the first set of Serial (SP-TCIM) cards under the DARPA SOCM contract. The second set of P-TCIM cards were on-loan to Boeing from a commercial supplier and, therefore, was returned to the supplier after the field demonstration. Fully operational SP-TCIM PC cards will be validated working in the ACT II delivered hardware, however, the actual PC cards will be delivered under the SOCM contract.

3.2 Initial Tests with Demonstration Hardware

The head-mounted displays proved fairly unreliable to work with during lab integration, dry runs, and again with actual field demonstration. The MALIB proved very reliable over the course of the project. The following describes the types of problems encountered during dry-runs at Ft. Polk, 12/97 which turned out to be some of the same problems encountered during actual field demonstration at NTC, 3/98: 1) **MALIB** -Operated as desired with 2 Duracell® batteries installed rated at 3.5 A/H for a total of approximately 7 hours without battery replacement or recharging. Replacement batteries performed the same which shows MALIB/Duracell operational consistency, 2) **Head Mounted Displays (HMDs)** - There were a total of four head mounted displays, Serial #s 1-4, for use on the project; Serial #s 1 and 3 were operational prior to the Ft. Polk dry-run and were the headsets integrated with the David Clark headsets (noise canceling microphones and noise suppressing earphones). The following is a brief synopsis of what was observed by the IMLSS Team and the customer at Fort Polk of each HMD: a) Serial # 1 and Serial # 3, Day 1: Both good all day, Day 2: Serial # 1 was good for about 2 hours and then begin to get dark and became inoperable. Replaced # 1 with serial # 3 and # 3 worked fine all day. No battery replacement was needed with the corresponding vest therefore it was concluded that HMD serial # 1 was malfunctioning. This was confirmed when HMD #1 was tested with external power connected to an operational vest and the same dark display was observed. HMD #1 remained inoperable and eventually had to be sent back for repair. The display for HMD #3 got dark and later, after being off, returned to normal, b) Serial # 2 and Serial # 4 were of poor resolution quality and would eventually be sent back for repair. After the failure of HMD #1 the David Clark Headset portion was removed and integrated with HMD Serial # 4, 3) **Headset Integration** -Both David Clark integrated headsets performed well with voice recognition software (Verbex) which allowed successful control of the TEDS software package loaded in the MALIB. The

Gentex noise canceling microphones and noise suppressing earphones attenuated shop noise well as reported by Fort Polk shop personnel, and as demonstrated by IMLSS while performing diagnostics on the turbine engine, 4) **MARSS Vest** - Four MARSS vest (serial #s 4-7) was available for the project. Serial numbers #5 and #6 were set up for voice recognition. Vest #06 also had Digital Multi-Meter (DMM) software installed. The outer shell that covers the auxiliary connector portions of vest #06 split after the user tried to perform maintenance on the tank. This split was severe enough that it exposed the MARSS motherboard, and 5) **Batteries** -The Duracell batteries took about 4 hours to totally charge with an initial charge from 0-25%. They did, however, perform as rated at 3.5 A/H.

3.3 IMLSS Software

The key feature of the Boeing developed IMLSS software was easy maneuverability and access to all the graphical user interface (GUI) screens for the maintainer. The software design focus on the ACT II / IMLSS project was to make the GUI as user-friendly as possible. A major hindrance to this effort centered on the GFE "page-turner" ETMs that are discussed in further detail later.

To accomplish a seamless IMLSS software design to the greatest extent possible, the following scenario was implemented for the IMLSS. At start-up, the Boeing developed "shell" GUI guides the maintainer to the appropriate vehicle or weapon system for maintenance and logistics activities. Once at these GUI screens, the maintainer chooses different command paths via keyboard, mouse, or voice command and, depending upon the application, the appropriate diagnostics function utilizing the Boeing developed Integrated Diagnostics Repair Information System (IDRIS). The shell GUI incorporates "hot-keys" for voice commands and "vacant" hot-keys were established for future IMLSS enhancements.

IDRIS allows the maintainer to perform automated system diagnostics totally "hands-free" if desired with complete mobility non line-of-sight around the Army system. Implementation of the diagnostics software allows location of a failed component, e.g. the Vehicle Motion Sensor (VMS) on a Paladin weapon system, which is reported from the MALIB via the 1553 data bus to the wearable maintenance vest via the wireless LAN. Once the failed component is identified, the maintainer can then navigate through the applicable ETM to find the remove and replace procedures for the component. The maintainer can then identify within the RPSTL the correct National Stock Number (NSN) and component description and proceed to fill out an electronic WO with all the information gathered. Finally, the maintainer can transmit the electronic WO to a shop supply for processing.

3.4 GFE ETM Software

Because the GFE provided ETMs are "page-turner" ETMs, i.e. portable document format (PDF) that allow text viewing only, Boeing had to utilize Acrobat Adobe PDF "plug-ins" to allow navigation through the ETMs. Additional software also had to be written to allow "hot keys" for implementing voice recognition with the ETMs. The Turbine Engine Diagnostics System (TEDS) which became part of the overall field demonstration did utilize a GFE Interactive ETM (IETM) that simplified screen navigation. However, even with some of these enhancements of the TEDS IETM, navigation through the various screens proved lengthy.

Only certain keys were "hot keys" that allowed voice recognition to be implemented. Therefore, several generic voice commands had to be implemented to compensate for the other data fields, like "next field", "previous field", or "move right/left two". The random tab-order of the keys did not allow easy navigation through any of the non-hot-keyed data fields and, some data fields could only be executed by use of an input device.

Navigation through the Boeing developed shell GUI that hosts all the vehicle and weapon system data fields was very seamless, however, the various encumbrances encountered with the ETMs did not allow seamless navigation through the ETMs when trying to perform maintenance and logistics tasks. The very nature of the "scanned-in" ETMs do not allow interactive functions, thus the encumbrances encountered imply more research and development needed in this area.

3.5 COTS Voice Recognition Software

The COTS voice recognition software caused some problems when attempting to navigate through the IMLSS GUI. After "voice-training" each individual user of the IMLSS, some words had to be "re-trained" in order to be recognized. Users also had to remember how words were enunciated when trained or the software would not recognize a word spoken a little differently. After re-training commands and users becoming more familiar with the Verbex software, screen navigation via voice became easier as the software responded more consistently. Limiting the frequency the microphone transmits should improve performance of the voice recognition software. This will reduce background noise to allow the software to center on clean voice print files.

4. Field Demonstration

With IMLSS system integration complete and all hardware and software elements tested in dry-runs and in the laboratory, the final field demonstration of the IMLSS took place at the National Training Center (NTC) at Ft. Irwin, Ft. Irwin, CA from 3/9/98 - 3/17/98. The following paragraphs describe the events and results of the ACT II IMLSS Concept Demonstration.

4.1 Boeing Hardware Inspection

Inspection and check-out of the following equipment and tools were performed upon arrival to the NTC 3/9/98: 1) 4 GFE MARSS wearable maintenance vests, serial numbers MARSS004 (M1A1 Maintenance Lane), MARSS005 (Not used), MARSS006 (HMMWV Maintenance Lane), and MARSS007 (Paladin Maintenance Lane), 2) 3 head-mounted displays with 2 integral noise canceling headsets, 3) 1 SOCM wearable maintenance vest, 4) 1 MALIB weapons interface box, 5) 1 experimental set of display/eyeglasses (Micro Optical Corporation), 6) 2 keyboards, 3 mice, 3 Twiddlers, 6 Proxim wireless LAN PC cards, 2 P-TCIM PC cards, and 2 bench-top power supplies, 7) 1 NEC laptop and 1 AST laptop for SINCGARS transmission, 8) 13 batteries for the vests and MALIB and 3 battery chargers, 9) 1 Automated Break-Out-Box (ABOB) for the M1 tank interface, and 10) 1 Kopin head-mounted display. All equipment checked-out fine for performing the field demonstration.

4.2 GFE Inspection

The equipment provided by the NTC was as follows: 1) 1 Paladin M109A6 self-propelled Howitzer, NSN 2350-01-305-0028, 2) 1 High Mobility Multi-purpose Wheeled Vehicle (HMMWV) M1097 Truck Utility Heavy, NSN 2320-01-346-9317, 3) 1 HMMWV M998 Truck Utility Cargo, NSN 2320-01-107-7155, and 4) 2 Abrams M1A1 Main Battle Tanks. The GFE checked-out fine for performing the field demonstration with the exception of the Paladin in which the Vehicle Motion Sensor (VMS) was "out". This actually was a good problem to have (as will be seen below) as the IMLSS detected this failed component unrehearsed.

4.3 Concept Demonstration Maintenance Personnel

Maintenance personnel utilized for the field testing included the Boeing team of Paul Janssen, Cedric Matthews, and arriving on 3/13/98 Mark Burcham; US Army Soldier Systems Command representation by Mark Chandler, Jim Sampson (Human Factors); Ft. Lee Combat Services Support Battle Lab representation by Chief Warrant Officer Dave Slaughter and Major Tim Raney from the Test and Evaluation Center (TECO-Lee); Ft. Polk Maintenance and Test Evaluation center (MATES 71) representation by SFC Kevin Cavanaugh and Billy Meyers; and the NTC soldier representation of NCOIC SFC Arvie Aguillon and crew for the Paladin Maintenance Lane, NCOIC SFC Gary Minnich and crew for the M1A1 Maintenance Lane, NCOIC SFC Edward Murray and crew for the HMMWV Maintenance Lane. In all, some 30 soldiers took part in the test and evaluation of the IMLSS for integrated maintenance and logistics on their vehicles and weapon systems. These soldiers, after completing their respective lanes, would then document their evaluation of the IMLSS for data collection to be presented at the Data Collection Meeting (DCM) following field-testing.

4.4 Voice Training

Tuesday through Wednesday, 3/10-3/11/98, was spent voice-training all of the Maintenance Lane NCOICs and soldiers. As the NCOICs became more familiar with the IMLSS and how to voice-train, they began training their own crews. Once voice training was completed, the individual Maintenance Lanes could be performed with the soldiers. Three Maintenance Lanes would be performed with the Paladin, HMMWV, and the M1A1.

4.5 IMLSS / Windows 95 Training

As will be seen in the following paragraphs, much effort was expended in training the soldiers utilizing the IMLSS on how to operate Windows 95, the overall IMLSS system, and getting them use to the Army ETMs. Some hardware problems were encountered as well with the IMLSS system, such as unreliable head-mounted displays (continual screen blanking) and the MARSS vests, such as flex cable problems causing boot-up freezes. The MALIB (with the exception of the one software driver problem that was corrected within 10 minutes) proved reliable throughout the entire testing period.

4.6 Maintenance Lanes

Initially, the Paladin Maintenance Lane was to be performed on Wednesday 3/11/98 at 0900, however, a software driver problem with the MALIB did not allow this to take place. The M1A1 Maintenance Lane did begin on 3/11/98 with the MALIB-to-ABOB-to-M1A1 interface working properly. An enhancement to this lane was an additional M1A1 Maintenance Lane that would require either a second MALIB or a laptop configured as a MALIB. Since no additional MALIB was requested for the project, and estimated time required to configure a laptop as an MALIB was 1-2 full days' effort, activity on a second M1A1 Maintenance Lane could not take place.

There were some initial attempts to configure another laptop as a MALIB but these attempts failed. These attempts were abandoned when installation of the Proxim wireless LAN drivers on the laptop failed and the driver installation program consistently "crashed" possibly due to the CardWizard software that was already installed on the laptop. No further attempts were made to try to implement the wireless LAN software drivers and alternate scenarios took place on the second M1 Maintenance Lane.

The original M1A1 Maintenance Lane, however, did perform well mainly due to SFC Kevin Cavanaugh's knowledge of the IMLSS and the TEDS IETM from a dry-run performed previously (12/97) at his facility (MATES 71) at Ft. Polk, LA. SFC Cavanaugh was very familiar with the IMLSS and with the TEDS IETM for doing interactive maintenance and logistics on the M1A1, which allowed a more seamless lane scenario. Some encumbrances were encountered with the wireless LAN with instances of poor connectivity between the M1 and the maintenance vest.

4.7 Adaptation to an Army ETM / Software Enhancements

Since the Maintenance Lane soldiers had never used Army ETMs prior to this field test, software changes were made on-site (see more detailed explanation below under **Field Demonstration Data Collection Meeting (DCM) Summary**) to help facilitate the soldiers navigating through the GFE ETMs. The additional software changes added more voice commands, such as, "next page", "previous page", "first page", "go-to page", and "order part". These changes were implemented after all voice-training had been completed, therefore, these commands had to be added manually to the voice files of each soldier assigned to the HMMWV and Paladin Maintenance Lanes.

A software addition for the HMMWV Maintenance Lane was also implemented to allow utilization of the standard Army 2407 WO for parts ordering. The IMLSS code had to be changed to accommodate this because the GFE ETM did not list NSNs for components of the HMMWV and, a part ordered without an NSN is incomplete and is ignored by the IMLSS software. Therefore, to accommodate utilization of the 2407 WO for the HMMWV, the IMLSS software was changed to accept incomplete part ordering, i.e. part number only for the HMMWV Maintenance Lane. An added feature to switch between the 2407 WO and the HMMWV ETMs was also created in the IMLSS software to allow the parts order list to be parsed every time the 2407 wizard was invoked for compilation of the parts data.

Additionally, the Digital Multi-Meter (DMM) software (originally only to be used for the HMMWV lane) was also installed on MARSS007 for the Paladin Maintenance Lane and different ETM volumes for the HMMWV and Paladin were loaded. This additional software was ported via direct link at LPT1 onto the vests from a laptop.

All of these software changes required a full day's attention by the Boeing team Wednesday, 3/11/98 and Thursday 3/12/98 and most of the day Friday, 3/13/98. Maintenance Lane performance was sporadic at best during these days as the lane scenarios started getting behind while the software changes were implemented. It became necessary to reduce some of the maintenance lane scenarios in order to recover schedule late Friday and into Saturday, 3/14/98.

4.8 Paladin Scenario

By late Friday afternoon, 3/13/98, the Paladin Maintenance Lane still had not been completely finished. Portions of the lane were complete, such as a 2407 WO transmission and navigation through the RPSTL for part identification, however, the critical function of capturing a fault with the MALIB's 1553 data bus and transmitting the fault via wireless LAN to the maintenance vest still had not been performed. Attention to the MALIB software drivers had been delayed throughout the week in order to accommodate the various on-site software changes, therefore, it wasn't until late in the afternoon 3/13/98 that new software drivers were installed into the MALIB allowing the 1553 data bus to begin operating properly. This installation took approximately 10 minutes. By Saturday morning 3/14/98, the Maintenance Teams were just beginning to operate

self-sufficiently without much interjection from the Boeing team. Problems were still being encountered but the frequency of these problems were beginning to wane by the end of the day Saturday, 3/14/98. Late in the afternoon of 3/14/98, the teams were ready to run the fault detection portion of the Paladin Maintenance Lane.

Originally, the plan was to actually interject a "Tube Temperature" fault into the Paladin weapon system and show the customer that the MALIB would capture the known fault via the MALIBs Paladin Monitor (PALMON) 1553 executable software. Once captured, the data would be ported via wireless LAN to be displayed on the head-mounted display of the maintenance vest. Instead of using the head-mounted display, however, the team hooked a monitor up to the maintenance vest so the data would be visible to all witnessing the test.

To get the test underway the MALIB was installed in the Paladin weapon system and its 1553 data bus was connected to the Paladin's. The MALIB was then powered up and was waiting to receive 1553 data bus messages from the Paladin weapon system. The wearable maintenance vest was then powered up approximately 50 yards away and after a moment successfully engaged the MALIBs wireless LAN and the two were successfully networked. Once all components of the IMLSS were in place, Chief Warrant Officer Dave Slaughter began start-up procedures for the Paladin.

To adhere to the original plan of fault interjection, before start-up the Paladin's "Tube Temperature" power cable was disconnected so that a "Tube Temp Out" message would appear on the 1553 data bus. After completing this and just moments after starting the Paladin weapon system, the wearable maintenance vest received a Vehicle Motion Sensor "VMS Out" message and not a "Tube Temp Out" message. Concerned that 2 failures may have actually been interjected by pulling the Tube Temperature power cable, the test was re-set and started again. However, this time before pulling the Tube Temperature power cable before start-up, the Paladin weapon system was started without any interjected failures in order to view the Paladin's own diagnostics menus first in order to insure a "clean" system baseline. The MALIB again captured a "VMS Out" message and after further investigation, the team found that the Paladin's internal diagnostics system was displaying the same failure. The MALIB had actually captured and displayed on the wearable maintenance vest a real fault in lieu of interjecting one. Other faults were also indicated by the Paladin's diagnostics system, therefore, if multiple failures are required for display for future demonstrations, this can be achieved via a simple change to the IMLSS software. This test completed the Paladin Maintenance Lane and successfully demonstrated the ACT II / IMLSS to meet contract requirements.

4.9 Maintenance Lanes Complete

By Monday, 3/16/98, the soldiers were pretty much on their own in working with the IMLSS. The Boeing team consisted only of Mark Burcham whose role at this point was support only to keep batteries re-charged for the wearable maintenance vests and the MALIB and to help with any problems that might arise. All Maintenance Lanes were successfully completed this day.

5. Field Demonstration Data Collection Meeting (DCM) Summary

On Tuesday, 3/17/98 at 0900, the DCM was conducted by Major Tim Raney to document the Maintenance Lane evaluation sheets for each of the 3 maintenance lanes. The following paragraphs are observations made as a result of this meeting.

5.1 General Discussion and Observations

In general discussion, it was observed during the lanes that many of the soldiers were not familiar with either the Windows environment or (I)ETMs, and that a lot of the participants in the Maintenance Lanes did not have vehicle experience, HMMWV experience for example. The overall sample size had an average of only 5-6 years maintenance experience and most of the soldiers had no prior experience using (I)ETMs. It was noted that navigation through the ETMs was very cumbersome with too many unnecessary options for the user, a factor of the ETMs themselves. In addition, more "hot keys" are needed in the IMLSS software (Hot keys such as "next page", "previous page", "first page", "go-to page", and "order part", which allowed easier navigation and were added on-site. These functions, however, were not initially installed because of the technical approach of the project in using GFE ETMs, i.e. utilize the ETMs as they are formatted without building "special code" to interface with them). Navigation through these ETMs will come easier as technological advances are made with ETM formatting and when migration begins to a "web-based" approach for ETM implementation and downloading from the Tactical Internet.

5.2 DCM Conclusion

The DCM concluded that the IMLSS was not sufficiently developed for a true operational demonstration and assessment of system capabilities and that the data collected supports this statement. The data collected did find, however, that the IMLSS did achieve stated goals and requirements for a "concept" demonstration of advanced maintenance and logistics by depicting "what could be". The Army, however, will not realize any military merit or utility from the IMLSS unless future development results in a small, simple, durable and lightweight system with a high degree of reliability, both in overall system operation and GFE ETM software.

6. Field Demonstration After Action Review (AAR)

On Tuesday, 3/17/98 at 1300, the AAR was conducted by Mark Chandler to receive feedback from the soldiers who participated in the field-testing and evaluation of the IMLSS. This activity was video recorded and the following observations were made as a result of this meeting.

In general survey with all the participating soldiers, 52% were familiar with Windows software; 44% were familiar with Windows 95; 26% were attempting to use the software for the first time; 0% used ETMs regularly; 7% had used an IETM; and 56% were seeing

an ETM for the first time; 56% felt like voice-control was important; 100% would use voice-control if it were more reliable; 37% would use the eyeglasses in lieu of the head-display, and, only 22% would want to use the head-display. These findings were consistent with the first week being used to train the soldiers on Windows 95 as well as Army ETMs and IETMs.

6.1 Soldier Feedback

In a 2-3 hour general discussion with all the participating soldiers, the following findings were noted about the different aspects of the Army ETMs and IETMs, and the IMLSS:

1) ETMs - Wasn't very user friendly, paper method is easier, parts look-up is very difficult, hard to navigate, diagrams and text too small to read on the head-mounted display, words hard to read even on a regular desk-top monitor, illustrations are too small, not enough detail, NSN missing on TEDS IETMs, would be easier if they used the ETMs and IETMs on a daily basis, even with 3 NCOICs operating the system for 5 days it was still hard to navigate, can't go straight to where they need to be in the ETM but they adapted to the situation, and the ETM snap-zoom was continually a problem, **2) Voice Activation** - Liked it, however, would prefer a better commercial software package that is universal that doesn't require voice-training; needs to be more consistent (only 9% consistently had Verbex working); need to be able to talk peer-to-peer; and did not like the idea of various voice files, **3) SOCM Platform** - More comfortable, smaller, not as hot, computer not as hot, very uncomfortable when laying on chest, too many wires to get in the way, concerned about the cost-effectiveness of the eyeglasses, would prefer a re-configurable system based on need and environment, head-mounted display too bulky and heavy, eyeglasses too heavy and too narrow field-of-view; and easier to use, however, didn't like the battery placement on the hip, **4) Boeing Software** - User friendly; desire a more universal software package to align with their different applications of tracked, turret, and wheeled vehicles; and transmission of Work Order via SINCGARS was easy, **5) Field Use?** - Overall consensus of the group: **NO**, however, some indicated use in a garrison situation. General consensus revealed the soldiers would rather use a laptop instead of the wearable system for the following reasons: too much equipment to put on, especially in war-time, and 90% of the time they know how to fix a vehicle/weapon system problem without even looking at the paper manuals, **5) Twiddler** - Effective if used all the time, didn't like the buttons, wires get in the way; and didn't like the "joy-stick" motion for pointer movement.

7. Post-Field Demonstration / Project Summary

It was evident from the Field Test that the soldiers were not ready for the IMLSS technology being displayed for use in maintenance and logistics activities. The soldiers were currently still performing maintenance and logistics activities with paper technical manuals and had not yet even begun using the Army standard ETMs and IETMs on laptops. Therefore, introducing any technology that went beyond a non-existent Army baseline created much frustration with the soldiers and "down-time" because of need to provide "basic training" on Windows 95, ETM, and IETM use.

This, in conjunction with the various IMLSS system encumbrances and on-site software changes needed to accommodate ETM shortcomings, expended 6 of the 8 days of Field Test time only allowing a short test cycle for data collection. These realities re-appeared in the AAR briefing only to suggest that this technology be beyond the Army baseline at present, i.e. paper technical manual use and limited ETM and IETM use for maintenance and logistics. As the Army baseline catches up with the wearable technology, however, the results should increase substantially in favor of the IMLSS for use in advanced maintenance and logistics activities.

From a technical standpoint, Boeing did demonstrate that the IMLSS could successfully interrogate a weapon system data bus and find a component fault, look up the component remove-and-replace procedures in the ETM, locate the component NSN and description in the ETM RPSTL, fill out a standard Army 2407 Work Order, and send the WO to a supply depot over SINCGARS. Furthermore, the elements of voice commanding and the wireless interface were successfully tested.

All of these components integral to the wearable IMLSS platform produced a successful *concept* technology demonstration depicting the viability of using the system in the future for advanced maintenance and logistics. Future research and development efforts should continue to enhance the human interface with wearable electronics and electronic media for optimizing advanced maintenance and logistics activities.

This document reports research undertaken at the U.S. Army Soldier and Biological Chemical Command, Soldier Systems Center, and has been assigned No. NATICK/TR-7702 in a series of reports approved for publication.

Appendix A

IMLSS Independent Operational Assessment Report



DEPARTMENT OF THE ARMY
UNITED STATES ARMY OPERATIONAL TEST AND EVALUATION COMMAND
TEST AND EVALUATION COORDINATION OFFICE-LEE
3901 A AVENUE SUITE 250
FORT LEE, VA. 23801-1809

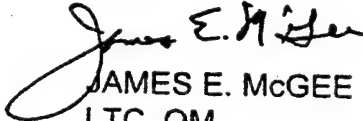
CSTE-TEO-CAS

7 May 1998

MEMORANDUM FOR Directorate of Combat Developments for Ordnance, ATTN: ATCL-O
(Mr. Charles G. Fish), 3901 A Avenue, Suite 250, Fort Lee, VA 23801-1809

SUBJECT: Integrated Maintenance and Logistics Soldier System (IMLSS) Independent
Operational Assessment Report

1. The IMLSS Independent Operational Assessment Report is attached. This operational assessment is the result of the IMLSS ACT II demonstration conducted at Fort Irwin, CA from 10 to 18 March 1998.
2. We welcome any questions concerning this report and look forward to assisting in future DCD-Ordnance projects. The point of contact for this assessment report is MAJ Timothy Raney, (804) 734-0084 or raneyt@lee-dns1.army.mil.


JAMES E. McGEE
LTC, QM
Chief, TECO-Lee

7 May 1998

Integrated Maintenance and Logistics Soldier System (IMLSS)

Independent Operational Assessment Report

**US Army Operational Test and Evaluation Command,
Test and Evaluation Coordination Office-Fort Lee,
3901 A Avenue, Suite 250, Fort Lee, Virginia 23801-1809**

Integrated Maintenance and Logistics Soldier System (IMLSS)
Independent Operational Assessment Report

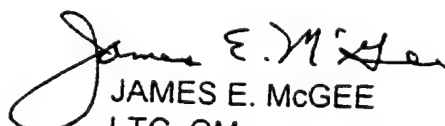
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Integrated Maintenance and Logistics Soldier System (IMLSS) Independent Operational Assessment Report

Executive Summary.

1. **Demonstration Overview.** This assessment report provides viable operational data to the combat developer to aid in refining the ACT II (pre-Milestone 0) brassboard prototype Integrated Maintenance and Logistics Soldier System (IMLSS).
- 1.2. All data was derived from the IMLSS demonstration conducted in garrison at Fort Irwin, CA from 10 to 18 March 1998. Directorate of Combat Developments for Ordnance, Combined Arms Support Command (CASCOM) is the proponent. The Operational Test and Evaluation Command (OPTEC), Test and Evaluation Coordination Office, Fort Lee VA (TECO-Lee) is the independent operational evaluator. The demonstration included IMLSS systems, soldiers and equipment (M109A6, HMMWV and M1A1). Data collection focused on human factors and operational issues. The OPTEC team collected data from subject matter expert observations, user surveys and data collection forms.
2. **Demonstration Findings.** The brassboard IMLSS prototypes were not sufficiently developed for a true demonstration and assessment of system operational capabilities. The collected data supports this statement. The IMLSS demonstration showed promise in improving maintenance operations by depicting "what could be:" Voice control software that allows access to electronic technical manuals and wireless communication for any "motor pool laptop personal computer (PC)." This allows mechanics to access, send or receive technical data quickly from the shop office or operating data from the vehicle itself. These capabilities, whether they reside in a conventional laptop PC or a wearable computer, should make maintenance operations more efficient. However, the Army will not realize any military merit or utility from IMLSS unless future development results in a small, simple, durable and lightweight system with a high degree of reliability.
3. Results of this "testing for learning" initiative should be used to further examine and refine system requirements and to promote development of IMLSS to meet validated operational needs of the soldier.
4. Point of contact for the assessment report is MAJ Timothy Raney, (804) 734-0084 or raneyt@lee-dns1.army.mil.


JAMES E. McGEE
LTC, QM
Chief, TECO-Lee

**Integrated Maintenance and Logistics Soldier System (IMLSS)
Independent Operational Assessment Report**

1. **Purpose.** The proponent conducted the Integrated Maintenance and Logistics Soldier System (IMLSS) operational demonstration to determine if the concept warrants further TRADOC investigation. This assessment provides preliminary operational data on the prototype IMLSS. This report summarizes results of the IMLSS operational demonstration; provides viable data for use in refining the system. This assessment addresses the system's operational issues and the associated data collection effort serves as the basis for this independent operational assessment.
2. **Background.** The proponent is the Directorate of Combat Developments for Ordnance, CASCOM. The IMLSS materiel developer is the Natick Research, Development and Engineering Center (NRDEC) and the contractor is Boeing. IMLSS is funded as an FY97 ACT II effort. Operational Test and Evaluation Command (OPTEC), Test and Evaluation Coordination Office, Fort Lee VA (TECO-Lee) is the independent operational evaluator.
3. **System Description.** IMLSS is a developmental, soldier-wearable computer system that allows access to its capabilities during maintenance operations. IMLSS is designed to allow the maintainer immediate and "hands-free" access to technical manuals and diagnostic capabilities when performing maintenance, e.g., on an M1A1 tank. IMLSS has two modes of data input; voice and manual (mouse). A head-mounted display (HMD) shows data; and wireless communication links the maintainer to a remote station to access additional data.
 - 3.1. **System Hardware.** IMLSS consists of a 133 MHz processor with 64 Mbytes RAM, two Gbyte hard-drive and desktop PC features. A HMD is an integral part of IMLSS. This display has 640 x 480 resolution with a standard VGA interface. The HMD also has a microphone and earphones for audio input/output.
 - 3.2. **System Software.** IMLSS uses maintenance and logistics software for compiling work orders and diagnostics functions and interfaces with different communications modes. The IMLSS software allows it to interface with the M1A1 tank turbine engine diagnostics (TED) system and Army electronic technical manuals (ETMs). IMLSS software allows the user to operate the system by voice command, mouse or keyboard. IMLSS software capabilities include; maintenance and logistics software for supportability functions and mission checklists, maps or tactical information; interfaces with Army or commercial communications (cellular phones, ISDN, telephone lines, SATCOM and the Internet).
4. **Scope Of Demonstration.** The IMLSS operational demonstration and data collection effort was conducted at Fort Irwin, California from 10 to 18 March 1998. IMLSS capabilities were demonstrated in a garrison maintenance facility (motor pool). The intent of the IMLSS operational demonstration was to provide baseline data on system performance, capabilities and operational utility. The combat developer will use demonstration results to refine the system and examine other uses for IMLSS, i.e., other tactical vehicles or logistics applications.

4. **Scope of Demonstration (cont.)**. The contractor provided four IMLSS prototypes for the demonstration. The demonstration consisted of three maintenance lanes: M109A6 Paladin, HMMWV, and M1A1 turbine engine diagnostics (TED). A target population of representative maintainers (63 and 45 series MOSs) used IMLSS to assist in maintenance and repair operations of these vehicles. The tasks performed in each of these maintenance lanes assessed different IMLSS capabilities. The maintenance lanes also included a "non-IMLSS" lane for providing baseline data, i.e.; mechanics performing maintenance using conventional automated and manual procedures. Mechanics were timed and surveyed as they completed each lane. A SINCGARS radio was used to transmit data to simulate communication of logistics data. The contractor provided IMLSS training to each mechanic before the demonstration. This training included voice control procedures and system capabilities.

5. **Data Collection**. The data collection effort focused on human factors engineering, system performance and capabilities. Data was collected in a garrison maintenance environment by the OPTEC team. The data was derived from direct observations recorded in data logs, user surveys, data collection forms and pertinent maintenance operations data. OPTEC (TECO-Lee) representatives conducted data collector training. The data collectors included senior NCOs and NRDEC civilians, who were well versed in data collection, survey design, MANPRINT, maintenance operations and IMLSS capabilities. Consequently, their observations are important to the independent evaluation and their role transcend the strict definition of data collector. TECO-Lee emphasized the importance of accurately completing the data collection forms and surveys. The demonstration database was developed by TECO-Lee. TECO-Lee representatives performed data entry using Excel, Microsoft Office 97.

6. **Demonstration Limitations**. This report contains limited operational information collected in a garrison environment over a nine-day period. The single most significant limitation was the very limited degree of IMLSS familiarization training provided to test soldiers. The relative complexity of the IMLSS makes familiarization training a mandatory requirement for a true operational assessment. The system observed was an immature prototype and not a production representative system. Due to the maturity level of IMLSS, the OPTEC team did not have the opportunity to collect data on issues relating to the system transmission of work orders and technical data via SINCGARS.

6.1. Statistical analyses in the report are not definitive because of the short test duration and the small population sample size. However, these data do accurately represent the subjective views of the soldiers who used the system. Certain standard items used to perform maintenance tasks were not available during the demonstration, i.e., only one digital multimeter (DMM) card was on-hand and this was used for the HMMWV. This limitation resulted in digital multimeter dependent tasks not being performed in the other lanes.

6.2. Additional test limitations included soldiers who lacked proficiency in performing tank diagnostics procedures using the turbine engine diagnostics system (TED) on the M1A1 tank. This lack of proficiency also occurred with M109A6 SP Howitzer and High Mobility Multi-Purpose Wheeled Vehicle (HMMWV). These soldiers received minimal, "on-the-spot" training pertaining to their specific vehicle assignment. Soldiers were then considered proficient enough to participate in the demonstration since replacement soldiers were not available.

6.3. Some soldiers were unfamiliar with using laptop computers in the maintenance environment. Consequently, they had difficulty comparing IMLSS with conventional computers and automated procedures used in a maintenance facility. Additionally, soldiers mentioned they were not very familiar with electronic technical manuals (ETMs) and would like to have had more familiarization training. Soldiers also perceived shortcomings of ETMs, but this is not necessarily a reflection on IMLSS.

7. **Training, Human Factors Engineering, Manpower and Personnel.** New equipment training (NET) is critical for this system. The OPTEC team observed several problems that may have been alleviated if the soldiers had received adequate training on the system (see "Demonstration Limitations" above). Aspects of human factors engineering (HFE) have been addressed under the "summary of findings under the applicable operational criteria and in the subject matter expert and data collector observations.

8. **Reliability and Maintainability.** Reliability and maintainability of the IMLSS was beyond the scope of this demonstration/assessment. The frequent IMLSS software and hardware problems prevented a more comprehensive demonstration of its capabilities. Reliability problems that occurred throughout the demonstration are reported elsewhere in this assessment.

9. **Operational Issues.** The following soldier (user) comments, data and survey results pertain to the IMLSS operational issues and criteria provided by the proponent. This report addresses each operational issue, the supporting criteria and focuses on how well the demonstration addressed these issues. Survey scores ranged from 0 (not at all); 1 (slightly); 2 (somewhat); 3 (moderately), 4 (very much) and 5 (extremely). This data is derived from OPTEC team observations, surveys and data collected during the demonstration events. See subject matter expert (SME) and data collector observations, presented in Annex A, for additional information.

9.1. **Operational Issue #1: Does the IMLSS improve the effectiveness of maintenance operations?**

NOTE: Findings from the demonstration for each criterion are addressed individually below. These findings are derived from surveys, timing of demonstration events and observations.

9.2. Criteria

9.2.1. IMLSS software will build an effective work order that is compatible with the Army Standard Maintenance System (SAMS). The software will generate a file input for SAMS.

9.2.1.1 Findings: System problems prevented the soldier from building an effective work order. Consequently, compatibility with SAMS was not verified. However, there were three instances (M109A6 lane) where a soldier successfully completed a work order using either voice control or manual entry. This demonstrated that this capability may be achievable in a more mature system.

9.2.2. Work order software will use voice control to minimize mouse and keyboard entries.

9.2.2.1 Findings: This criterion was not addressed because of system deficiencies indicated in the findings of Criteria "a". System problems prevented the soldier from building an effective work order as stated above. During the AAR, soldiers mentioned additional development is needed so "voice training" is not required, this way anyone can use a given IMLSS. A total of nine soldiers (out of 24) indicated voice control worked consistently. Soldiers felt the system should be more reliable. Additionally, work orders were completed on the M109A6 only.

9.2.3 ILMSS work order software will not increase work order preparation time compared to the current system.

9.2.3.1. Findings: This criterion was not confirmed because in many instances system problems prevented the soldier from building an effective work order as stated above. IMLSS demonstrated the capability to build a work order, but three iterations do not represent a statistically significant sample size. The limited scope of familiarization training may also have adversely affected the findings for this criterion. During the AAR, soldiers mentioned they want tailored software for a given unit, i.e., Ordnance, Military Police, Armor, etc., based on the equipment in those units. Soldiers also expressed the desire to have the ability to order parts verbally; it was difficult to change applications, i.e., changing from the digital multimeter to the ETMs.

9.2.4. IMLSS will use existing Electronic Technical Manuals (ETM). IMLSS will provide equal readability of ETMs compared to current methods and computers.

9.2.4.1. Findings: The demonstration confirmed the IMLSS use of existing ETMs. However, providing equal readability compared to current methods and computers was not confirmed. The survey subdivided this into three parts: illustrations, text and use of a laptop PC with ETMs. Survey results showed the mean was 2.92 (viewing illustrations) or somewhat to moderately better than existing systems. A mean of 2.70 or somewhat better for reading text, was indicated by the target population survey results. When comparing IMLSS to laptop PCs, the soldier survey data resulted in a mean of 2.45, or somewhat better than using a laptop PC (see Annex D, graphs 5,6 and 7).

9.2.5. IMLSS will provide equal to or better use of the RPSTL (repair parts and standard tools list) in the ETMs.

9.2.5.1. Findings: The capability was confirmed during the demonstration. Survey results showed a mean of 3.33 or moderately better than existing systems. (see Annex D, graphs 8 and 9).

9.2.6. IMLSS will transfer files from one computer to another using wireless LAN and SINCGARS.

9.2.6.1. Findings: This capability of data transfer via SINCGARS was confirmed twice during the demonstration. This data could have been transferred during each of the 18 iterations soldiers performed tasks on the M109A6. However, the actual number of successful data transfer trials was not explicitly stated. This indicates the capability exists but system maturity prevented the consistency required of more developed systems.

9.2.7. IMLSS will remotely control diagnostic computers used for Turbine Engines and Paladin.

9.2.7.1. Findings: This capability was demonstrated on 7 occasions with TED on the M1A1 tank. The demonstration showed the capability exists. However, this is insufficient data to indicate the IMLSS enhanced soldier could repeatedly perform the tasks. Additionally, loss of contact between IMLSS and TED occurred throughout the demonstration. The frequent IMLSS software and hardware problems prevented a more comprehensive demonstration of this capability.

9.2.8. IMLSS will provide a digital PC card multimeter that will provide equal or a better capability compared to the existing multimeter. ETM and digital multimeter software will run simultaneously so the maintainer can compare meter readings to specifications in the ETM.

9.2.8.1. Findings: The demonstration showed this capability exists. The digital multimeter was used 11 times out of a possible 22 times or was successful 50% of the time (based on HMMWV tasks). However, frequent IMLSS software and hardware problems prevented a more comprehensive demonstration of this capability. Additionally, there was only one digital PC card multimeter available for the demonstration (also see Demonstration Limitations).

9.2.9. IMLSS will provide equal or greater speed (compared to current system) of diagnosis/troubleshooting while providing a hands-free capability and freedom of movement around the weapon system.

9.2.9.1. Findings: Findings were derived from the TED scenario used during the demonstration: *"Initiate work order on TED. Diagnose faults using TED; perform operational checks and diagnostic procedures. Repair as possible and verify repairs. Determine parts required and post them to the work order. Transmit work order to the shop office"*. Based on the limited data collected, the IMLSS required approximately 57% more time to perform TEDs troubleshooting tasks compared to the baseline (conventional laptop PC). However, this data only provides an indication of those relative times to perform certain tasks and is not considered statistically significant. Again, frequent IMLSS software and hardware problems prevented a more comprehensive demonstration of this capability. Additionally, training on both IMLSS and M1A1 tank maintenance tasks affected the results. Annex D, graphs 10 and 11 show time required to perform the tasks in the TED M1A1 scenario. When using IMLSS, soldier's felt they could troubleshoot systems "moderately to very much" as indicated by the mean survey score of 3.69 shown in Annex D, graph 12.

9.2.9.1.2. Findings-Hands Free Capability : In addition to troubleshooting, this criterion addressed "hands free" capability and "freedom of movement" around the weapon system or vehicle. Survey results shows that soldiers using IMLSS were able to move around vehicles during the initial inspections. However, based on it current configuration, IMLSS restricted movement when worn in the confines of a combat vehicle. Survey data shows that soldiers gave IMLSS ratings from 2.10 to 2.41 or "somewhat" easy to either crawl under or climb over equipment (see Annex D, graphs 13 and 14).

9.3 Findings for Operational Issue #2: Is the IMLSS operationally suitable for maintenance operations?

9.3.1. IMLSS will withstand maintenance inspection and diagnostics operations.

9.3.1.1. Findings: This criterion was not confirmed. The IMLSS saw limited use in maintenance diagnostics operations. Additionally, IMLSS is a brassboard prototype and does not have the durability required of a production representative item. Soldier survey statistics for system durability resulted in a mean of 1.92, or close to "somewhat durable" (See Annex D, graphs 1 and 2). For a more detailed summary, see Annex A, "Subject Matter Expert and Data Collector Observations."

9.3.2. IMLSS must be comfortable to use and wear.

9.3.2.1. Findings: Based on survey data and SME observations, IMLSS was comfortable to wear and this criterion was demonstrated. However, system improvements to make IMLSS easier to adjust are required with fewer cords and snaps. See Annex A, "Subject Matter Expert and Data Collector Observations for a detailed summary of SME observations.

9.3.3. IMLSS will be as easy to use as a laptop computer.

9.3.3.1. Findings: This criterion was not confirmed. Based on survey data and SME observations, IMLSS was not as easy to use as a laptop. The survey results indicate the mean score for this criterion was 2.45 or the IMLSS was "somewhat easier" to use than a laptop computer. These scores reflect the degree of system training and familiarization; the degree of experience soldiers had with personal computers (see Annex E); and the brassboard prototype nature of IMLSS (its current state of development). The soldiers were also asked if they liked the IMLSS design, i.e., a wearable computer; and if IMLSS was designed with their jobs in mind. The survey shows a score of 2.60 or "somewhat" to moderately liking the IMLSS design and 2.00 or the IMLSS being "somewhat" designed for their jobs. Additionally, see "Subject Matter Expert and Data Collector Observations" and "Annex D, graphs 7, 15 and 16.

9.3.4. IMLSS must be safe to use and not introduce additional hazards.

9.3.4.1 Findings: The IMLSS appeared to introduce additional hazards. Wires and/or cords hanging from IMLSS were potential safety hazards when working around equipment. The IMLSS appeared to restrict soldiers' vision, i.e., survey scores were 2.14 and 2.62 and indicated vision was "somewhat" restricted. During the AAR, soldiers were also concerned about hanging wires, HMD being too bulky and suggested using something configured similar to a "Sony Walkman." They also mentioned wanting a smaller system, one that is more reliable and durable with longer battery life. Additional suggestions included eliminating the vest and adding the remote capability to a laptop computer.

9.3.4.1 Findings (cont.): Improving the display and making ETMs easier to read were other suggestions. The "twiddler" mouse was difficult to use and mouse was required when the voice control failed. The IMLSS allowed soldiers to move safely around vehicles (except where noted above). Survey results show a score of 2.96, indicating a "moderate" hampering of free movement around a vehicle, but not necessarily a safety hazard. IMLSS allowed soldiers to hear in a motor pool environment with background noise provided by an idling M109A6 Paladin SP howitzer. However, survey results show a score of 3.11, indicating a "moderate" interference with hearing. From a different perspective, this moderate interference with hearing could adversely affect a soldier's ability to diagnose vehicle faults that rely on hearing, i.e., listening to unusual mechanical noises that may signal component malfunction or failure. Although soldier data rated IMLSS as "moderately" safe to use with a score of 3.07, observations showed there were hanging wires, straps and cords that can become caught in equipment. Under certain circumstances, the head-mounted display (HMD) can obstruct vision and was mentioned previously. In both cases, these are potential safety problems. For additional comments, see Annex A, "Subject Matter Expert and Data Collector Observations" and Annex D, graphs 17 through 21.

9.4 Operational Issues and Criteria Summary of Findings. The systems were not sufficiently developed for a true assessment of their operational capabilities. The limited scope of the system familiarization training and frequent system failures resulted in the operational issues not being confirmed. Soldier survey responses resulted in a mean of 2.33 or "somewhat useful," for field operations. Soldier survey statistics for system durability resulted in a mean of 1.92, or close to "somewhat durable".

9.4.1. The survey scores show the target audience felt the IMLSS was "somewhat" better than current maintenance equipment, procedures and reflect these limitations (see Annex D, graphs 1 and 2). During the After Action Review (AAR), soldiers felt the system should be used in garrison, not in the "field." This comment was based on the perceived lack of system durability. Another suggestion was to use the system for inspections only. Some soldiers remarked that the capability of transmitting work orders was good; "if improvements were made to the system, it might be good in a field environment".

9.4.2. Another important aspect of these operational issues are system efficiency, i.e., the time required to perform a given maintenance task using the IMLSS verses conventional procedures and equipment. The results do not provide enough statistical significance to address this portion of the operational issues. This information on relative times may provide developers with a baseline to judge future efforts. In the case of selected HMMWV maintenance tasks, conventional procedures were almost four minutes faster than using the IMLSS, i.e., time to complete the task using baseline procedures took a mean time of 18.27 minutes verses 21.81 minutes when using IMLSS (see Annex D, graph 3,4).

9.4.3. The demonstration showed the potential for a wireless computer to interface between a maintainer, diagnostics equipment, the vehicle and shop office. This wireless interface has the potential of making maintenance operations more efficient. However, "Operational suitability" also includes software, employment, logistics supportability, transportability, training, MANPRINT, reliability and maintainability, and interoperability. Logistics supportability and transportability were not addressed; other areas of operational suitability are addressed elsewhere in this report. Due to the abbreviated demonstration and the IMLSS level of development, a true assessment of its maintenance capabilities did not occur.

Subject Matter Expert and Data Collector Observations

1. This section summarizes OPTEC, subject matter expert (SME) and data collector observations during the IMLSS operational demonstration. The observations below are categorized by the IMLSS subsystem, i.e., software, head-mounted display and input device (mouse). These are non-quantitative observations as written below, but are supported elsewhere in this report by quantitative analysis.

1.2. Software (voice recognition and operating software). In a representative motor pool, with background noise provided by an idling M109A6 SPH, the voice recognition software was not recognizing spoken commands; some commands were then entered manually to compensate for voice recognition problems. Soldiers were "voice trained" and that voice file was stored on the "c" drive of a particular IMLSS central processing unit (CPU). This voice training took approximately 15-20 minutes per soldier. However, soldier's frequently repeated voice commands before the system would respond.

1.3. Navigating through the electronic technical manuals (ETMs) presented problems when the soldier could not find the correct page or section. This is not necessarily an IMLSS-specific fault. However, the task of finding the right page took more time. On other occasions, the soldier could access the ETM, but would get an unrelated screen and required additional instruction by an NCO on how to page through the ETM. Voice commands to "minimize Windows" were done repeatedly and soldiers had difficulty in searching for correct pages in ETM. This also occurred using other voice commands, i.e., "enter" was spoken several times without a response.

1.4. Soldiers also appeared to have problems controlling the software, searching for pages/sections within ETMs and required assistance from NCOs. Soldiers would often use a voice command and when that did not work, used manual input. The CPUs would "lock-up" periodically and were restarted. This problem appeared to occur more frequently when the soldier enabled the "zoom" function for the screen. In some instances, the soldier would "click" and go to the wrong page; he/she could get to one page, but not another. Once they found the page, they could not get the correct paragraph or another window "pops up." When using the digital multimeter, the multimeter function would periodically disappear off the screen or would not respond to voice commands. Subject Matter Experts (SME) also felt that some software problems, i.e.; navigating through the ETM was due to the ETM software and not IMLSS.

1.5. Input Device (Vest-Mouse and "Twiddler"). In addition to voice commands, the two other means to input data were the vest-mounted mouse and "twiddler" multifunctional mouse. These input devices were used to supplement voice command data entry or were used in lieu of it. Soldiers had difficulty navigating through ETM by using these input devices.

1.6. Input Device (Vest-Mouse and "Twiddler") (cont.) The twiddler was complex and difficult to use without adequate familiarization training. It is more complex than a conventional input device (mouse) and does require a training period before the user becomes proficient. Soldiers often changed back and forth between twiddler and vest-mouse. Soldiers frequently became frustrated with trying to use the input devices. In several instances, soldiers were using two hands to operate the twiddler and would then put the twiddler down to have both hands free to work. Soldiers also changed from twiddler to vest-mouse periodically during a scenario. If one input device were not responsive, they would try the other one.

1.7. Some soldiers had very little control with input devices. For example, one soldier began a page search with vest-mouse and took 10 minutes to find the proper page. Trying the vest-mouse again, it took this soldier approximately 15-20 minutes to access two to three pages in the ETM. However, in this case, he was successful using the twiddler to order parts from the ETM and wrote remarks in on the electronic work order form.

1.8. Soldiers also used voice command and then relied on mouse input. Soldiers had difficulty with the twiddler and changed to the vest-mouse while still looking for the correct ETM page. At one point, it took a soldier approximately 24 minutes to use the digital multimeter to check battery voltage due to IMLSS system problems, i.e., input devices were difficult to use. It actually took 1-2 minutes to measure battery voltage once the soldier was able to input the commands, navigate through the ETM and use the digital multimeter function.

1.9. Head Mounted Display (HMD). After positioning the HMD with both hands, some soldiers would still hold the HMD with one hand. Soldiers also were seen squinting at the display every time they used it throughout a task. In other cases, they could not see the display, or had problems with the "zoom" feature. In other instances, sunlight reflecting off the HMD made the screen virtually impossible to read.

1.10 Soldiers also had difficulty seeing the screen and positioning the digital multimeter probes. Some soldiers used one hand to shield the screen from extraneous light to make it easier to see the screen. This occurred indoors under artificial lighting and in sunlight. One soldiers' eyes appeared to be watering when looking at the screen.

1.11. Some soldiers were able to use the HMD with both eyes open, but still stayed in the shade when looking at the screen. When using the zoom feature to read ETM text, letters are too large and get in the way. The screen also "blanked-out" periodically. Using the "zoom" function, one soldier did page searches, held HMD with one hand and crawled through the vehicle (M109A6).

1.12. Other System Hardware. IMLSS wires/equipment were banging against vehicle. Soldier does not appear to be trained on this equipment (M109A6). He puts wires back in the vest when crawling through vehicle. The IMLSS vest as designed, is bulky and hindered soldiers when they were crawling through a vehicle to perform routine maintenance functions in accordance with the different scenarios, i.e., vehicle inspection, troubleshooting, using the digital multimeter, etc. Wiring from the vest-input devices to the CPU interfered to varying degrees with performing the maintenance functions. In some cases, the soldier needed two hands to tuck the wires out of the way. Potential safety problems with the wiring include getting these wires caught in the equipment.

USA OPTEC APPROVED FOR RELEASE.

User Comments from Surveys Summary.

1. A total of 28 user surveys were administered to IMLSS users immediately after using the system. The following comments are extracted from the surveys' comments section and categorized by the system the soldiers worked on. These comments are presented for informational purposes only, without prejudice or analysis.

2. M1A1 Tank/TEDS.

2.1. I really like the system, a lot easier and faster. I really thought this program was very interesting. I think it will be used very much in the Army. But I still think it needs a little work on the voice activation system. But, other than that, it is a pretty nice system. Thank you for letting me test your project.

2.2. IMLSS worked moderately well with experienced mechanics. Software needs to be more user-friendly. Battery life is too short. LAN (local area network) connection was easily lost. System connections came loose easily. I like the concept, not the delivery.

2.3. Batteries went dead too fast. Vest could not be closed correctly because of the computer. Voice control software was not good. None of the equipment (IMLSS) was remotely durable enough. The headset (HMD) gave headaches after having it on for 40 minutes to one hour.

2.4. Too complicated for an everyday soldier to get any usefulness out of (unless Boeing provides software and hardware engineers). System was not prepared for testing. Laptop computer was over twice as fast as IMLSS. It was just too loose fitting.

2.5. I had trouble with my mouse, it kept going out. If we had a vest that had more outside pockets to store the mouse. It would be all right if the batteries and other components were smaller. Very good design. It would be useful in the future Army. It will also be very good if they could design it to work on all Army vehicles. I didn't have any experience on M1's or computer and the system made it very easy to me.

3. High Mobility Multipurpose Wheeled Vehicle (HMMWV).

3.1. Too many wires! They kept catching on things. Too bulky and slid around too much. If less bulky and less wires or something to hold the wires away, it would work great.

3.2. With some improvements, i.e., size, weight, heat distribution and sensitivity of the microphone, this system would at least be practical. I do like the concept of this but...seemed heavy on the right side; screen flickered when my arm touched the right side of the vest; wires seemed to catch on things; I like the way the mouse works, awkward at first, need practice!

3.3. Doesn't seem practical for everyday mechanic, for as often as you look into the screen you could have a laptop on a table off to the side; a little too much. System needs a lot of improvements to be used in a real working environment.

3.4 Hardware too sensitive to be used by a hard working soldier. Lots of glitches in voice commands. I feel it's not good for this job. I think it would get in the way if you're trying to make an adjustment in the engine. It could also be dangerous if you are on an engine and one of the straps could get caught on something. Even the multimeter plugs and mouse control. I think it's a waste of time and money.

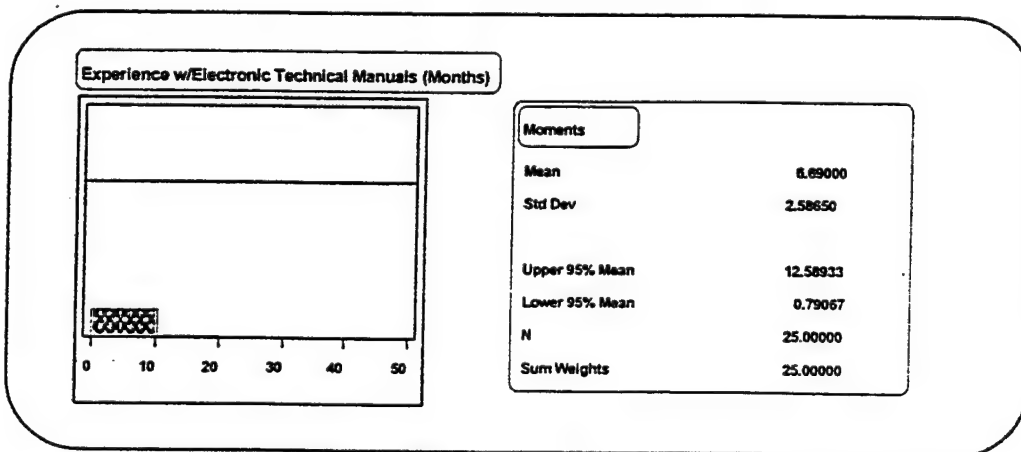
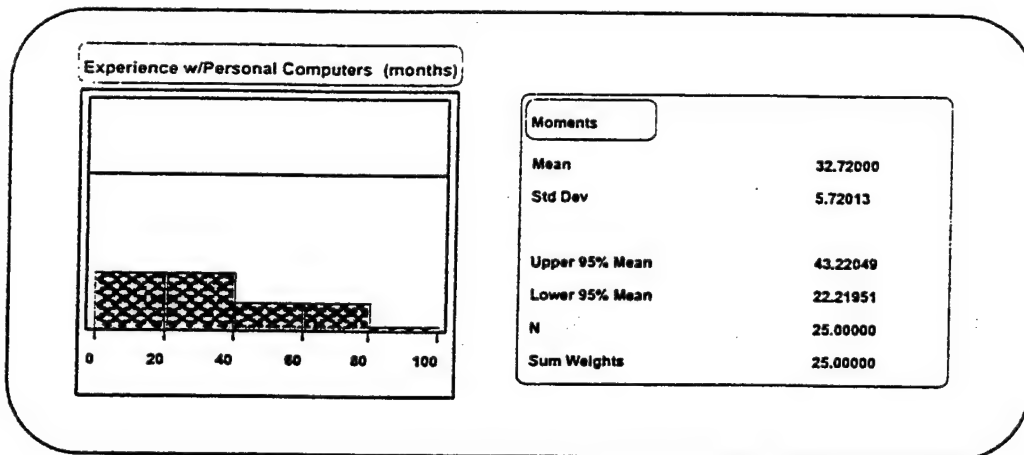
4. M109A6 Paladin Self-Propelled Howitzer.

4.1. Total system not well designed for user. Needs total redesign of input devices, software and head-mounting (HMD). "Not ready for prime time" (M109A6).

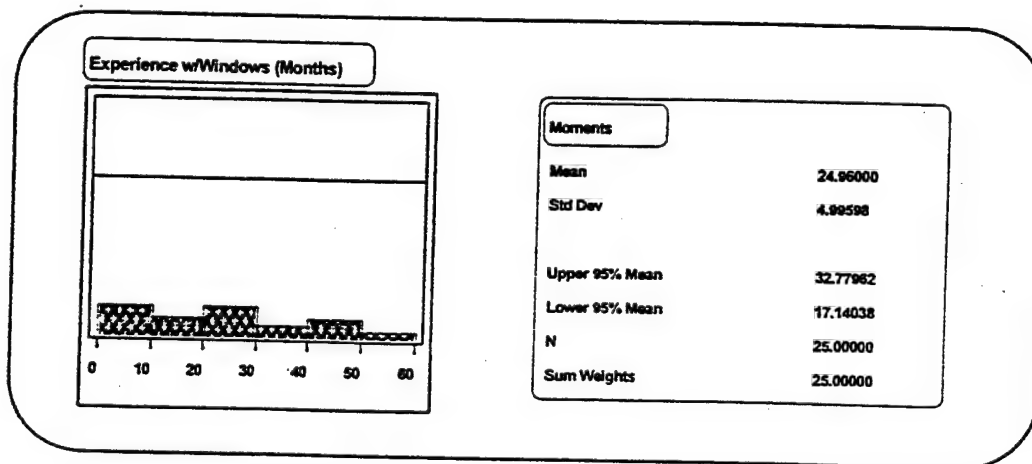
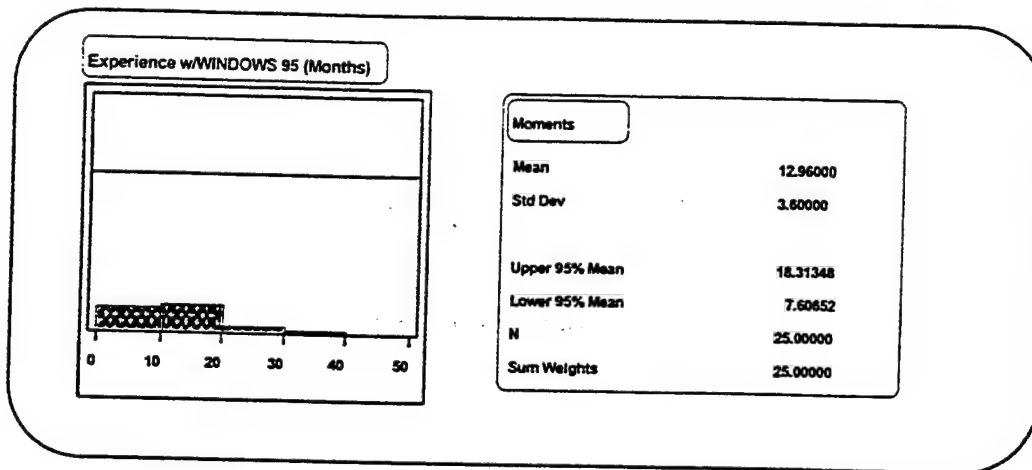
4.2. Files kept opening up; mouse would open things up on its own; voice commands didn't work that great; the vest is too loose; the vest didn't have enough pockets. Wires hang all over the place. Could get caught up on something and cause injury.

Computer Experience Data

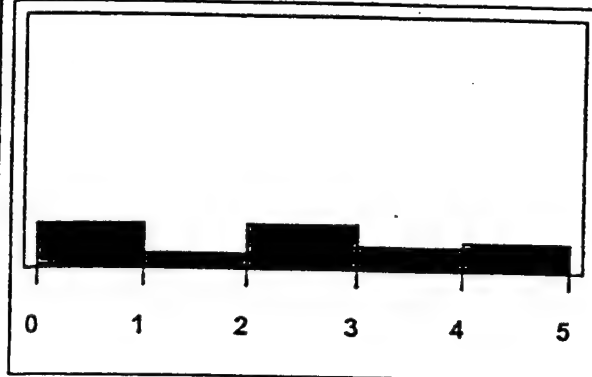
1. This is a summary of computer experience data for soldiers who participated in the IMLSS operational demonstration. Data summaries indicate the demonstration soldiers had an average of 32.72 months experience with personal computers and 6.69 months of experience with electronic technical manuals (ETMs).



2. This same population had an average of 24.96 months experience with the Windows operating system and 12.96 months with Windows 95. Based on this data, the demonstration soldiers (as a whole) were experienced with personal computers and Windows applications.



SEEMS DURABLE/STRONG Graph#1

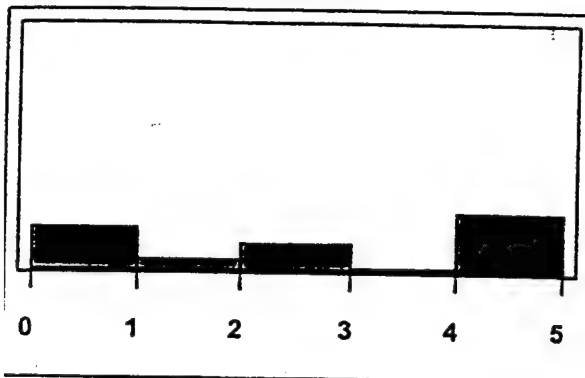


Quantiles

Moments

Mean	1.92308
Std Dev	1.54721
Std Error Mean	0.30343
Upper 95% Mean	2.54800
Lower 95% Mean	1.29815
N	26.00000
Sum Weights	26.00000

USEFUL IN FIELD OPS Graph#2

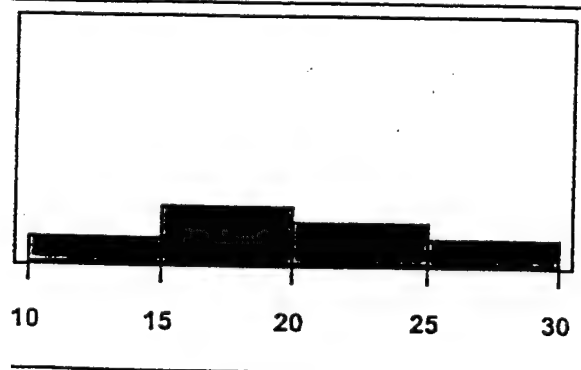


Quantiles

Moments

Mean	2.33333
Std Dev	1.95789
Std Error Mean	0.42725
Upper 95% Mean	3.22455
Lower 95% Mean	1.44212
N	21.00000
Sum Weights	21.00000

HMMWV TIME BASELINE(min)Graph#3



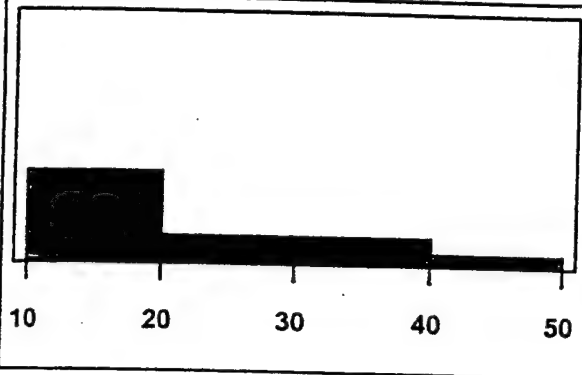
Quantiles

Moments

Mean	18.27273
Std Dev	5.76352
Std Error Mean	1.73777
Upper 95% Mean	22.14474
Lower 95% Mean	14.40072
N	11.00000
Sum Weights	11.00000

5A. Footnote: Quantiles not shown.

HMMWV TOTAL TIME IMLSS Graph#4

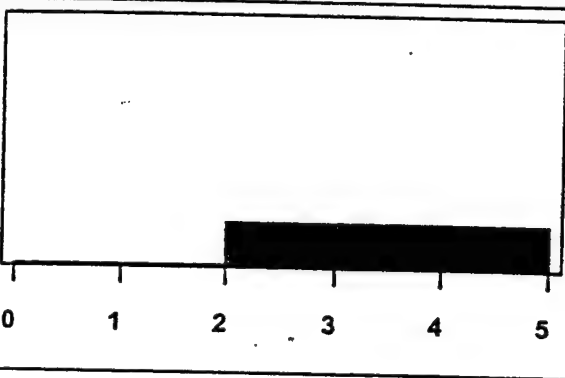


Quantiles

Moments

Mean	21.81818
Std Dev	11.32094
Std Error Mean	3.41339
Upper 95% Mean	29.42374
Lower 95% Mean	14.21262
N	11.00000
Sum Weights	11.00000

ILLUSTS EASY TO READ Graph#5

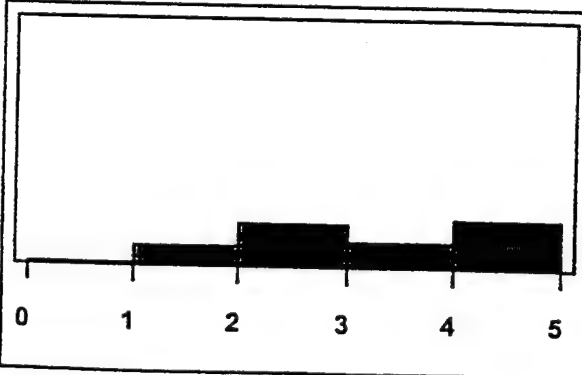


Quantiles

Moments

Mean	2.92308
Std Dev	1.23038
Std Error Mean	0.24130
Upper 95% Mean	3.42004
Lower 95% Mean	2.42612
N	26.00000
Sum Weights	26.00000

TEXT EASY TO READ Graph#6

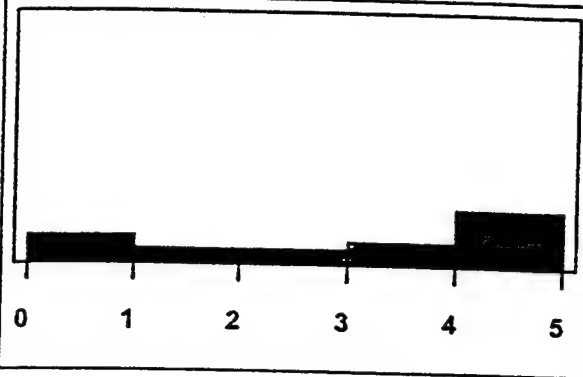


Quantiles

Moments

Mean	2.70370
Std Dev	1.32476
Std Error Mean	0.25495
Upper 95% Mean	3.22776
Lower 95% Mean	2.17965
N	27.00000
Sum Weights	27.00000

BETTER THAN LAPTOP Graph#7

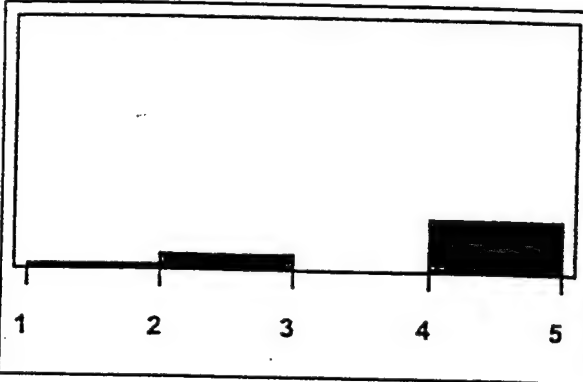


Quantiles

Moments

Mean	2.45833
Std Dev	1.71893
Std Error Mean	0.35087
Upper 95% Mean	3.18417
Lower 95% Mean	1.73250
N	24.00000
Sum Weights	24.00000

CAN USE TEDS RPSTL Graph#8

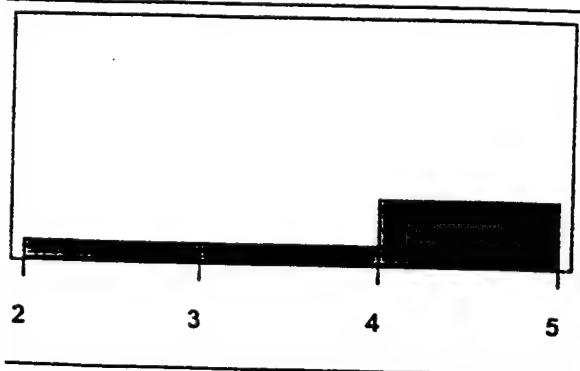


Quantiles

Moments

Mean	3.333333
Std Dev	1.322876
Std Error Mean	0.440959
Upper 95% Mean	4.350195
Lower 95% Mean	2.316471
N	9.000000
Sum Weights	9.000000

CAN USE HMMWV RPSTL Graph#9

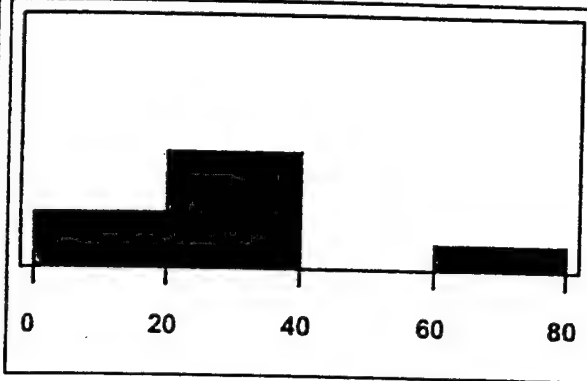


Quantiles

Moments

Mean	3.800000
Std Dev	1.303840
Std Error Mean	0.583095
Upper 95% Mean	5.418910
Lower 95% Mean	2.181090
N	5.000000
Sum Weights	5.000000

TEDSBASELINE TASK(MINS)Graph#10

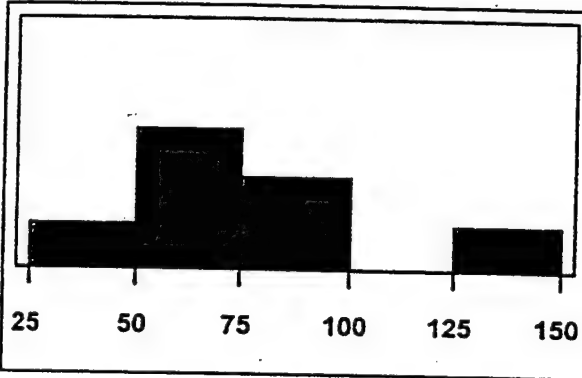


Quantiles

Moments

Mean	31.57143
Std Dev	19.92366
Std Error Mean	7.53044
Upper 95% Mean	49.99776
Lower 95% Mean	13.14510
N	7.00000
Sum Weights	7.00000

TEDS IMLSS TASK (MINS)Graph#11

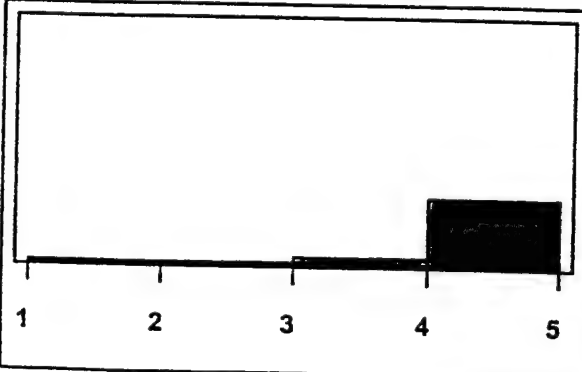


Quantiles

Moments

Mean	74.0000
Std Dev	34.6266
Std Error Mean	13.0876
Upper 95% Mean	106.0243
Lower 95% Mean	41.9757
N	7.0000
Sum Weights	7.0000

TROUBLESHOOT ELECT SYS Graph#12

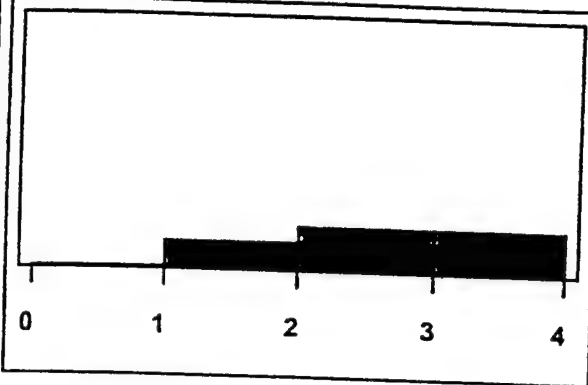


Quantiles

Moments

Mean	3.69565
Std Dev	1.22232
Std Error Mean	0.25487
Upper 95% Mean	4.22422
Lower 95% Mean	3.16708
N	23.00000
Sum Weights	23.00000

CRAWL UNDER WITH Graph#13

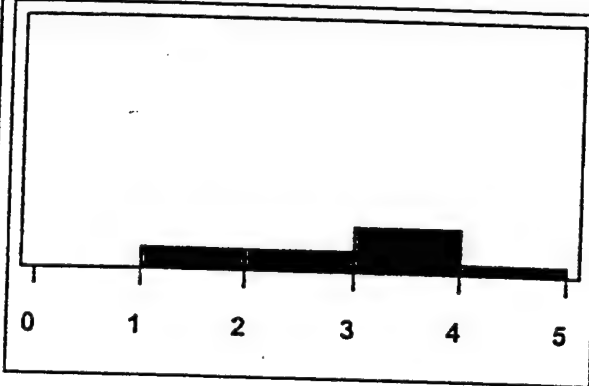


Quantiles

Moments

Mean	2.10000
Std Dev	1.07115
Std Error Mean	0.23952
Upper 95% Mean	2.60131
Lower 95% Mean	1.59869
N	20.00000
Sum Weights	20.00000

CLIMB OVER WITH Graph#14

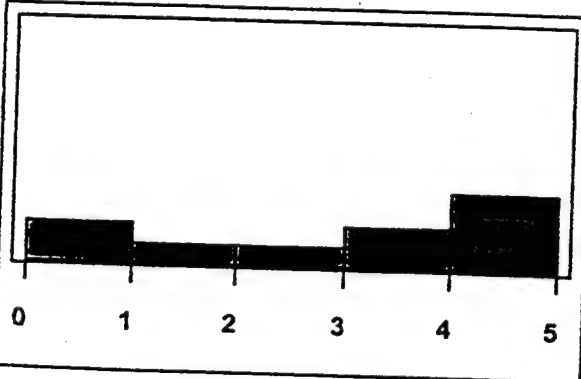


Quantiles

Moments

Mean	2.41667
Std Dev	1.17646
Std Error Mean	0.24014
Upper 95% Mean	2.91344
Lower 95% Mean	1.91990
N	24.00000
Sum Weights	24.00000

LIKE OVERALL DESIGN Graph#15

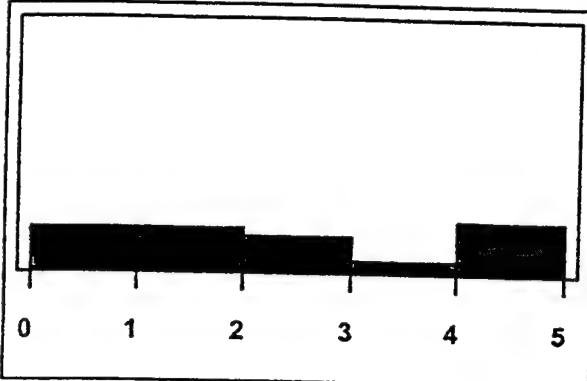


Quantiles

Moments

Mean	2.60000
Std Dev	1.82574
Std Error Mean	0.36515
Upper 95% Mean	3.35362
Lower 95% Mean	1.84638
N	25.00000
Sum Weights	25.00000

DESIGNED FOR MY JOB Graph#16

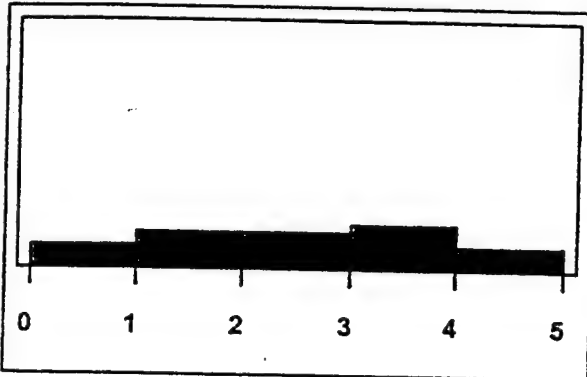


Quantiles

Moments

Mean	2.00000
Std Dev	1.67332
Std Error Mean	0.32817
Upper 95% Mean	2.67586
Lower 95% Mean	1.32414
N	26.00000
Sum Weights	26.00000

DOES NOT IMPAIR VISION Graph#17

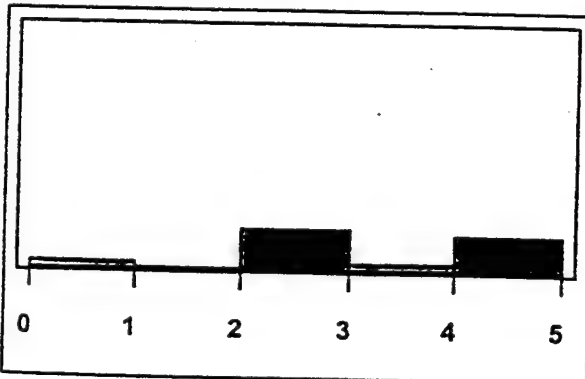


Quantiles

Moments

Mean	2.14815
Std Dev	1.51159
Std Error Mean	0.29091
Upper 95% Mean	2.74611
Lower 95% Mean	1.55019
N	27.00000
Sum Weights	27.00000

SEE THINGS OK Graph#18

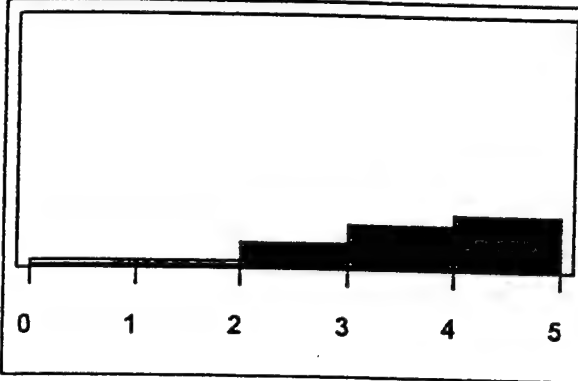


Quantiles

Moments

Mean	2.62963
Std Dev	1.54791
Std Error Mean	0.29789
Upper 95% Mean	3.24196
Lower 95% Mean	2.01730
N	27.00000
Sum Weights	27.00000

MOVE AROUND VEH Graph#19

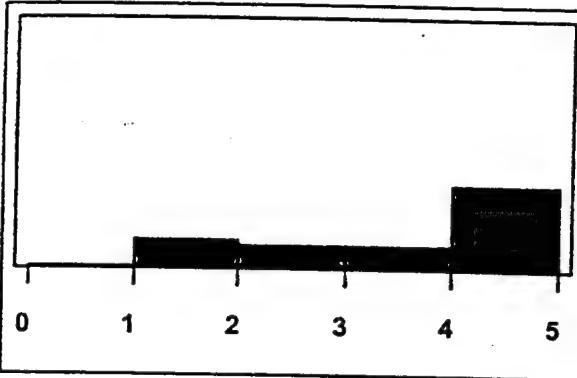


Quantiles

Moments

Mean	2.96296
Std Dev	1.42725
Std Error Mean	0.27467
Upper 95% Mean	3.52756
Lower 95% Mean	2.39837
N	27.00000
Sum Weights	27.00000

ALLOWS YOU TO HEAR Graph#20

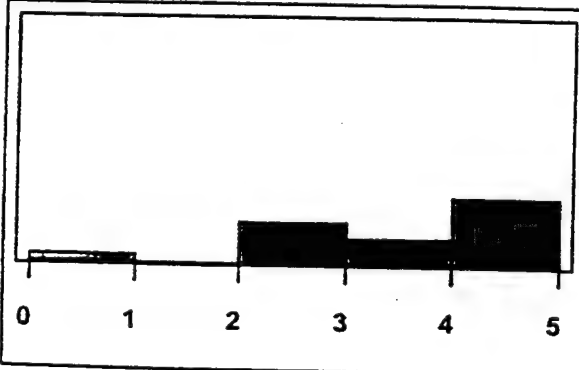


Quantiles

Moments

Mean	3.11111
Std Dev	1.60128
Std Error Mean	0.30817
Upper 95% Mean	3.74455
Lower 95% Mean	2.47767
N	27.00000
Sum Weights	27.00000

WAS SAFE TO OPERATE Graph#21



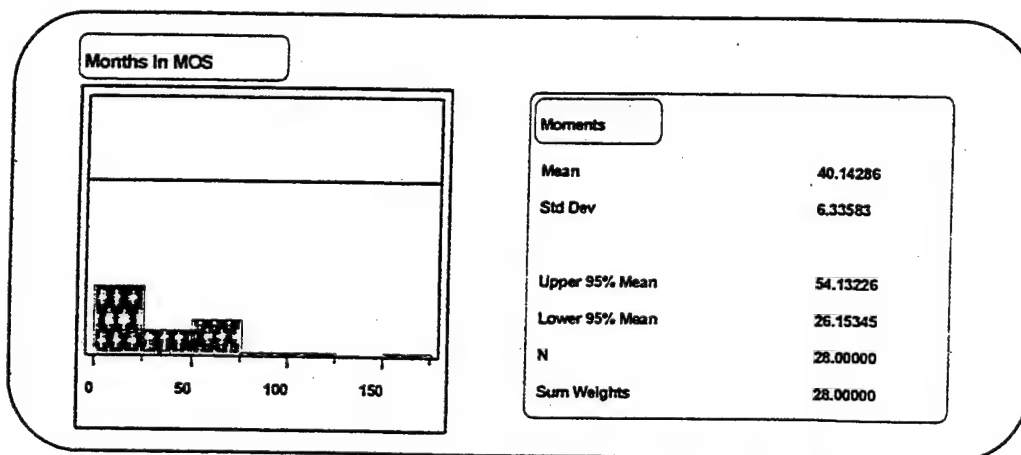
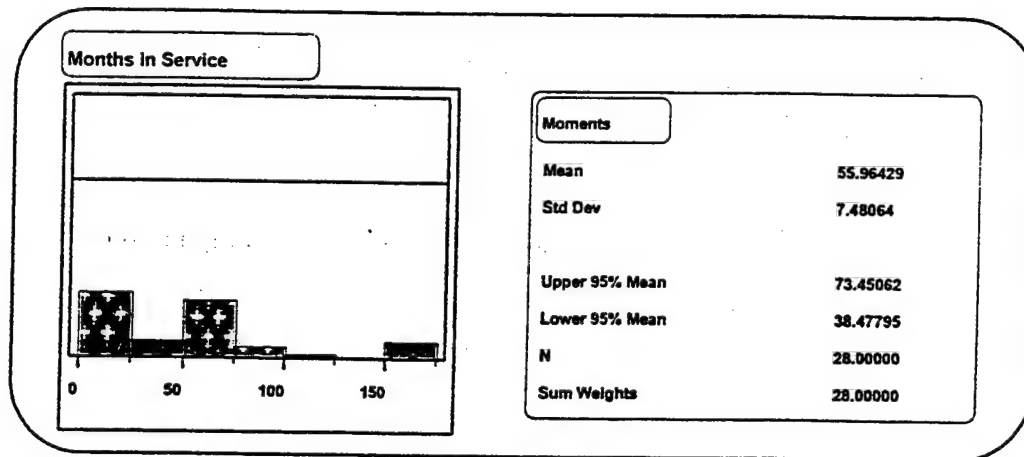
Quantiles

Moments

Mean	3.07692
Std Dev	1.52113
Std Error Mean	0.29832
Upper 95% Mean	3.69132
Lower 95% Mean	2.46253
N	26.00000
Sum Weights	26.00000

Demographics Data

This is a summary of demographics data for soldiers who participated in the IMLSS operational demonstration. Data summaries below indicate the demonstration soldiers had an average of 55.96 months in the Army and 40.14 months of experience in their respective military occupational specialties (MOS).



Appendix G

5 FEBRUARY 1997 DRAFT

Abbreviated Test Plan for Integrated Maintenance and Logistics Soldier System (IMLSS)

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TOPIC	SECTION
TEST OBJECTIVE	1.1
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TEST CONCEPT	3.0
BACKGROUND	3.1
TESTING	3.2
TESTING LANES DESCRIPTION	3.2.1
PILOT TEST	3.2.2
COMMUNICATIONS EQUIPMENT	3.4
INSTRUMENTATION AND OTHER SUPPORT	3.5
TEST PROCEDURES	4.0
GENERAL	4.1
CRITERIA	5.0
DATA	6.0
TRAINING	7.0
EXECUTION	8.0
OPERATIONAL ISSUES	9.0
DATA COLLECTION	10.0
MAINTENANCE LANES SCENARIOS	APPENDIX 1
OPERATIONAL ISSUE CHARTS	APPENDIX 2
DATA COLLECTION SURVEY SHEETS	APPENDIX 3

3. Introduction
3. Identification and Purpose of Test
4. Location and Dates of Test
5. System Description
6. Test Control
7. Scenario and Events
8. Training
9. Safety & Environmental Assessment Report
10. Instrumentation
11. Data Collection & Analysis
12. Other Topics

SECTION 1. INTRODUCTION

1.1 TEST OBJECTIVE

Provide data to the Directorate of Combat Developments for Ordnance (DCD-ORD) to determine if the Integrated Maintenance and Logistics Soldier System (IMLSS) enhances the conduct of maintenance operations.

2.0 System Description:

The IMLSS consists of Pentium 133 MHz processor with up to 64 Mbytes RAM, 2 Gbyte hard drive and other desktop PC workstation features configured as a soldier wearable system. An Active Matrix Electroluminescent (AMEL) head mounted display (HMD) is an Integral component of IMLSS. It provides 640 x 480 resolution at a 60 Hz frame rate with a standard VGA interface in a comfortable, lightweight and rugged package. The HMD also incorporates a microphone and earphones to allow audio input and output. IMLSS can be operated by voice command, mouse or keyboard. IMLSS capabilities include; maintenance and logistics software for supportability functions and mission checklists, maps or tactical information; interfaces with Army or commercial communications (SINGARS, cellular phones ISDN, telephone lines, SATCOM and the Internet. Future data and communications architectures capabilities and compatibility include the Tactical Internet, processing multi-media applications, graphics and video applications (maps, tele-maintenance, and tactical overlays), storing brigade level logistics database, interfacing with SAMS and interfacing with high speed high resolution video.

A recent technical break-through as occurred during the execution of the program. A new type of HMD has been developed under another DAPRA program that integrates miniature displays into an ordinary pair of eyeglasses. This new DAPRA HMD effort has revolutionized the concept of wearable computing. The glasses reduce the weight and bulk of current HMDs while providing protective and prescription (if required) eye wear for the maintainer. Since the new eyeglass HMD was only recently invented, this evaluation will include the use of one pair of eyeglass in the test matrix. The eyeglass-based display will be evaluated to determine if it should be the objective HMD for the maintainer.

The wearable computer will be a design that was developed by DAPRA for the Special Operations Community. The vest-mounted computer is very rugged and has a requirement to be submersible. The wearable computer of this design should be rugged enough to meet the maintainer needs.

An objective system description is depicted in figure 1-1. It should be noted that the other break through for the maintainer is in the development of the STE-ICE PC CARD. The MICOM RDEC anticipates that this card will be available in 4th QTR 98. It will not be part of this experiment. Note: the STE-ICE PC Card is shown in figure 1-1 for future use.

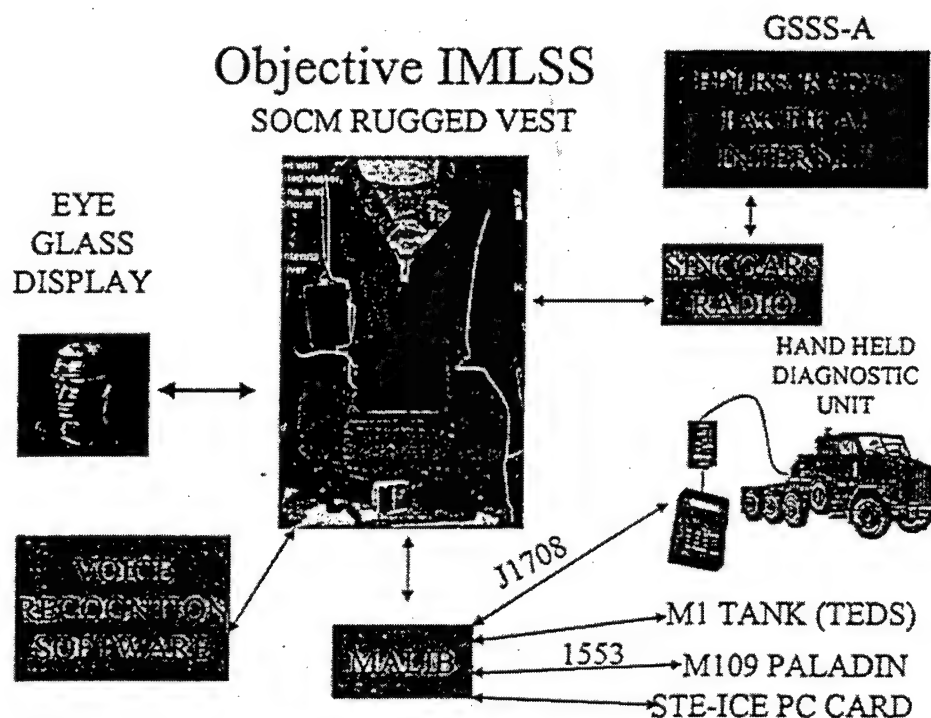


Figure 1-1

3.0 TEST CONCEPT

3.1 BACKGROUND

Wearable computers suitable for maintenance applications are available due to development of commercially available Heads-Up Displays (HMD). These displays provide the same capabilities of a desk top monitor. The Army has made a decision eliminate paper maintenance manuals by converting to Electronic Technical Manuals (ETM) by October 1998. Consequently, future mechanics will read these manuals using a desk top monitor, laptop computer, combat test set (or its replacement), or a wearable computer. The DCD-ORD wants to determine if the hands free feature of this system provides an increased capability for the maintenance soldier. If accepted by DCD-ORD, maintainers will use IMLSS at all organizational, direct support and general support maintenance levels. The crew level will still use paper technical manuals.

The IMLSS will also provide the maintainer with hands free capability to control diagnostic test equipment. The IMLSS will have a built in Digital Multimeter and run the Turbine Engine Diagnostic System (TEDS) software and control the Automatic Breakout Box (ABOB). The ILMSS will monitor the 1553 data buss in the M109A4 Paladin by using the Maintenance and Logistics Interface Box (MALIB). This will replicate the Combat Test set for this test. Controlling MALIB will demonstrate remote control of the Combat Test Set (and potential replacements) and any other Windows-compatible computer. The IMLSS will have the capability to use PC Card data buss reader cards for newer data busses (J1708 and 1939).

Current communication with maintenance support teams "down range" is not adequate. The IMLSS will use current tactical radios to digitally transfer logistics information to the maintenance control section. This will provide detailed, real-time maintenance and supply information on combat readiness to the logisticians and will result in more efficient repair operations. As the

tactical internet becomes a reality, IMLSS will use it for transferring work order files from one address to another.

3.2 TESTING

The test will be conducted at the National Training Center. The contractor will provide five IMLSS for testing. Four of the five vests are from a DARPA program; one vest is the objective system. The Army will use this "objective system" as a basis for future procurement. ALL vests will operate the same software. The DARPA vests have a flex mother board design that provides 6 PC card slots. The maintenance application does not require 6 PC card slots. The objective system will provide 4 PC card slots and a conventional mother board that will reduce future procurement costs.

Testing will consist of 3 maintenance lanes: Paladin, HMMWV, and TEDS. These maintenance lanes will evaluate different capabilities of the IMLSS. The maintenance lanes will also include a non-wearable lane (except the Paladin lane) with similar tasks as a baseline for comparison, i.e.; the mechanics will perform maintenance operations using conventional procedures and equipment. Each mechanic will be voice trained on the wearable computer before the test. It is anticipated that the test scenarios in their respective lanes will last no more than 1 hour. The mechanics will be timed as they complete each lane and surveyed immediately after the completion of each lane. Table 1 below illustrates this break down:

TABLE 1
Lane Execution with (W) and without (W/O) IMLSS

<u>MOS</u>	<u>Total #</u>	<u>TEDS (W)</u>	<u>TEDS (W/O)</u>	<u>HMMWV (W)</u>	<u>HMMWV (W/O)</u>	<u>PALADIN</u>
63H/W	9	9	9			
63B	12			12	12	
45K	8					8

Total number of test soldiers required = 29

All 63B and 63H/W will perform tasks with and without the ILMSS.

3.2.1 TEST LANE DISCRIPTION

There are three test lanes; TEDS, Paladin, and HMMWV. Each of these lanes were chosen to examine some part of the tasks maintenance soldiers are required to perform. The TEDS lane purpose is to determine the value of having hands free voice control of diagnostic test equipment. The TEDS system provides one of the most robust diagnostic software available anywhere. To control the software while making actual adjustments to the running tank engine is not practical with a Laptop computer. The wearable computer is ideal for this task. The Paladin lane purpose is to look at value of the IMLSS for the turret mechanic. The IMLSS will read the Paladin data bus error codes. The current ETM will be running on the vest and will be voice control to the extent possible. The Paladin lane will provide insight on

interaction with legacy ETM's. The HMMWV lane will address the needs of the wheel mechanic. The lane will require the mechanic to perform actual repair and replace tasks to determine the restrictions of a wearable system on those tasks. The HMMWV will evaluate the use of a voice controlled Digital Multimeter. The HMMWV lane will also incorporate use of the DAPRA eyeglass display. All of the lanes will require the soldier to create a work order and send it via the SINCGARS radio to another computer. The maintenance support team down range will be able save time by communicating there requirements to the shop office so that the decision can be made to Fix, Recover, or Abandon the repair of the vehicle do to lack of parts.

3.2.2 PILOT TEST

There will be a Pilot Test for each of the 3 lanes prior to the start of actual testing and data collection. The purpose of this is to insure that the soldier received the proper training, that the tasks on the maintenance lanes yield the school solution for what is wrong with the vehicle, and verify data collection procedures. The Pilot Test will take one of the trained mechanics for each lane and have him execute the approved scenario for that lane. The mechanic will use the IMLSS to determine the fault and send the work order.

3.4 COMMUNICATIONS EQUIPMENT

Two SINCGARS Radios are required and provided by the National Training Center Support Battalion at Ft. Irwin Ca. These radios will transmit data to simulate communication of logistics information on the battlefield. The HMMWV lane and the Paladin Lane will use the communications software developed for IMLSS to transmit files to the maintenance control section computer. The IMLSS will have the necessary software and PC cards to demonstrate this capability.

3.5 INSTRUMENTATION AND OTHER SUPPORT

The National Training Center Support Battalion will provide the following:

- 2 M1A1 Tanks
- 2 ABOBs
- 1 M109A6 Howitzer
- 2 HMMWVs
- 2 SINCGARS Radios with operational frequencies
- 3 VGA monitors for training
- 1 Video Camera/with Blank tapes to record each lane
- Coordinate with AAR theater to conduct final AAR and record it

Boeing will provide:

- 5 IMLSS vests
- 10 Batteries for vests
- 1 MALIB with batteries
- Cables for connection to Howitzer
- 3 Laptop Computers

4.0 TEST PROCEDURES

4.1 General

It is expected the actual test will last 1 week. Voice training, new equipment training, and the Pilot Test will be conducted prior to test start with minimum disruption to unit activities. A general orientation of the IMLSS will include a consolidated lecture by Boeing that will last approximately two hours. The Test Training Plan will be used for individual IMLSS training of test mechanics and data collectors. The orientation may require one to two days to ensure that the test mechanic is thoroughly familiar (and comfortable) with using the IMLSS. This orientation period includes approximately one to two hours for adequate voice training for each mechanic. The Test Training Plan is contained in ANNEX 4. Figure 2 listed below outlines test lane execution.

Test Soldier Participation Matrix

Day 1 of Testing

TIME	TEDS WITH IMLLS LANE A	TEDS WITH IMLSS LANE B	HMMWV WITH IMLSS LANE C	HMMWV WITHOUT IMLSS LANE D	PALADIN LANE WITH IMLSS LANE E
0800-0900	SUBJECT #19	SUBJECT #20	SUBJECT #1	SUBJECT #2	SUBJECT #11
0900-1000	SUBJECT #20	SUBJECT #19	SUBJECT #2	SUBJECT #1	SUBJECT #12
1000-1100	SUBJECT #21	SUBJECT #22	SUBJECT #3	SUBJECT #4	SUBJECT #13
1300-1400	SUBJECT #22	SUBJECT #21	SUBJECT #4	SUBJECT #3	SUBJECT #14
1400-1500	SUBJECT #23	SUBJECT #24	SUBJECT #5	SUBJECT #6	SUBJECT #15
1500-1600	SUBJECT #24	SUBJECT #23	SUBJECT #6	SUBJECT #5	SUBJECT #16

Day 2 of testing

0800-0900	SUBJECT #25	SUBJECT #26	SUBJECT #7	SUBJECT #8	SUBJECT #17
0900-1000	SUBJECT #26	SUBJECT #25	SUBJECT #8	SUBJECT #7	SUBJECT #18
1000-1100	SUBJECT #27	SUBJECT #28	SUBJECT #9	SUBJECT #10	SUBJECT #
1300-1400	SUBJECT #	SUBJECT #	SUBJECT #10	SUBJECT #9	SUBJECT #
1400-1500	SUBJECT #	SUBJECT #	SUBJECT #11	SUBJECT #12	SUBJECT #
1500-1600	SUBJECT #	SUBJECT #	SUBJECT #12	SUBJECT #11	SUBJECT #

63B are test Soldiers #1-10

63H/W are test Soldiers #11-18

45K are test Soldiers #19-27

5.0 CRITERIA

a. The IMLSS Software will build an effective work order that will be compatible with the Army Standard Maintenance System (SAMS). The software will generate a file input for SAMS.

- b. The work order software will use voice control as much as possible to keep mouse clicks and keyboard entries to a minimum.
- c. The ILMSS work order software will not increase time prepare work order over the current system.
- d. The IMLSS will use the existing Electronic Technical Manuals (ETM). The IMLSS will provide equal readability of ETM as compared to the current methods and computers.
- e. The IMLSS will provide equal to or better use of the RPSTL in the ETM.
- f. The ILMSS will transfer files from one computer to another using wireless LAN, and the SINCGARS radio.
- g. The IMLSS will be rugged to with stand maintenance inspection and diagnosis tasks.
- h. The IMLSS will be able to remotely control diagnostic computers used for the conduct Turbine Engines and the Paladin.
- i. The IMLSS will provide a digital PC card multimeter that will provide equal to or better capability that the existing multimeter. The ETM and the digital multimeter software will run together on the IMLSS so that readings from the Meter can be compared to the specifications in the ETM.
- j. The IMLSS will be as easy to use as a laptop computer.
- k. The IMLSS must be comfortable to use and wear.
- l. The IMLSS will provide equal to or greater speed (compared to current system) of diagnosis/troubleshooting while providing a hands-free capability and freedom of movement around the weapon system.

6.0 DATA

The data collection will consist of gross time measurements and test subject survey sheets. There will be survey sheets developed for each maintenance lane. The Questionnaire will be administered as the mechanic completes the scenarios in both lanes. On the Paladin Lane, the questionnaire will be administered upon the completion of the lane. The Questionnaires are located in Annex 1

Gross time measurements of lane completion will be kept. Test soldiers will randomly be selected to first to perform the ILMSS lane and then perform the manual lane or perform the manual lane first then the IMLSS lane. As an example, 5 soldiers will perform Lane C first then Lane D. Then the other 5 soldiers will perform Lane D first then Lane C.

The time measurement of sub tasks will be identified in the lane by the scenario. The data collection procedures will require the mechanic to notify the data collector at the start and finish of specific

tasks in that lane. This data will be use to provide insights in to just where in the maintenance process does the IMLSS provide the greatest user value."

There will be one data collector for each vehicle lane. The data collector will observe both soldiers, the one using the IMLSS and the one not wearing the IMLSS. The data collector will use simple time measurements for each vehicle lane. At the completion of the each lane the data collector will administer the questionnaires to the soldiers. NRDEC will provide the data reduction function under the direction of the TECO representative.

Additionally, an After Action Review will be conducted to get collective comments from the test soldiers. The After Action Review will take place in the After Action Review Theater. The review will be video taped to ensure accuracy and completeness. The after review comments will be documented in the test report.

7.0 TRAINING

Training on the system will consist of two phases.

7.1. Phase One. The DCD-ORD representative will provide background on the test and what is expected of the soldiers and data collectors. Then the Boeing representatives will provide a general orientation of the IMLSS.

7.2. Phase Two.

a. The second phase will include voice training, familiarization the IMLSS, and data collector orientation. This training is expected to take one to two hours per soldier. Personnel from Boeing and MATES 71 will voice-train the soldiers. This is necessary when comparing the IMLSS to current maintenance operations, systems and procedures.

b. Mates 71 personnel will provide training on the IMLSS loaded with the turbine engine diagnostic (TEDS) software. The soldiers that do the TEDS lane will build a voice file for the controlling TEDS prior to the test. MATES 71 personnel will also provide training on the hook ups/connection to the IMLSS vest. It is expected this dry run for TEDS hook up and operation will take 45 minutes to ensure all the voice commands and communications will work properly prior to the test. Personnel from Mates 71 will evaluate the level of expertise of the soldiers using the TEDS system to document the level of competency of the operator as "experienced" or "novice".

c. The training for the other lanes will consist of voice file building, hands on use of the vest, use of the DMM and walking through software for work order development. Each soldier will have a test on the use of these features prior to leaving the vest training. Boeing will develop this test and results will be recorded.

d. In addition to hardware, work order software and voice training, the Test Team will have a training station for file transfer. Each soldier will learn how to hook up the IMLSS vest to the radio and transfer files via radio to the receiving computer.

e. Data collectors will observe training in all phases. Part of phase two training will be instructions to the soldiers and data collectors on administering the questionnaires.

f. The Test Team will conduct training on paper technical manuals and electronic technical manuals (ETM) to ensure all test soldiers are proficient at using these methods of accessing data. The Test Team will also provide training on the using ETM for the lap top computers for each lane. Ideally, all test soldiers must be equally proficient on all systems, i.e., baseline(s) and the ILMSS. The lap top computers will be set in mono screen mode to simulate the ETM reader that will be provide by SPORT.

8.0 EXECUTION

See Appendix 1

APPENDIX 1

HMMWV Lanes

TASK 1. Schedule service performance and diagnostic troubleshooting using a digital multimeter (PCMCIA version), as necessary, while wearing the MARSS vest and using an electronic technical manual (ETM), for reference.

- A. Using the ETM as reference go to table 2-1 and perform item number 2c.
 - identify equipment you are inspecting
 - verbally record results
- B. Using the ETM as reference go to table 2-1 and perform item number 3e.
 - verbally record results
- C. Using the ETM as reference go to table 2-1 and perform item 10a.
 - verbally record results
- D. Using the ETM as reference go to table 2-1 and perform item 19a.
 - Verbally record results
- E. Using the ETM as reference go to table 2-1 and perform item 21c.
 - Verbally record results
- F. Using the ETM as reference go to electrical diagnostic flowchart and perform tasks 1 – D2 using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

TASK 2 Scheduled service performance and diagnostic troubleshooting using a digital multimeter as necessary, using a paper technical manual and recording results on DA form 2404 or ULLS automated format.

- A. Using the TECHNICAL MANUAL as reference go to table 2-1 and perform item number 2c.
 - identify equipment you are inspecting
 - verbally record results
- B. Using the TECHNICAL MANUAL as reference go to table 2-1 and perform item number 3e.
 - verbally record results
- C. Using the TECHNICAL MANUAL as reference go to table 2-1 and perform item 10a.
 - verbally record results
- D. Using the TECHNICAL MANUAL as reference go to table 2-1 and perform item 19a.
 - Verbally record results
- E. Using the TECHNICAL MANUAL as reference go to table 2-1 and perform item 21c.
 - Verbally record results

F. Using the TECHNICAL MANUAL as reference go to electrical diagnostic flowchart and perform tasks 1 – D2 using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

TEDS LANE A

SCENARIO ONE

SITUATION:

You are assigned to 333rd Maintenance Company and are on Support Team A. You have reached A 33 (M1A1). The crew has reported that the engine was in protective mode and that now it will not crank. The vehicle has been prepared for you to troubleshoot.

TASK:

Initiate work order on TED. Diagnose faults using TED, operational checks, diagnostic procedures. Repair as possible and verify repairs. Determine parts required and post them to work order. Transmit the workorder to the shop office.

CONDITION:

In a motor pool environment, using IMLSS or laptop, SINCGARS radio, tools and supplies provided.

STANDARD:

Completely and correctly perform following:

1. Develop work order electronically.
2. Diagnose faults.
3. Repair and verify as possible.
4. Determine parts required.
5. Transmit work order.

*WARNING!!!

Warning screens may come up telling you not to perform certain actions with the engine in the tank. For this scenario engine in tank is authorized provided that the following safety measures are taken.

1. Final drives disconnected.
2. Vehicle securely choked.
3. All unnecessary personnel cleared from area.
4. Turret hydraulic power disabled and zero pressured.

TEDS LANE A
SCENARIO ONE
FAULT REQUIREMENT

EQUIPMENT CONDITIONS:

Final Drives disconnected, vehicle choked.
Main gun elevated with engine access plate and doors open.
ABOB installed.

TOOLS:

Laptop or IMLSS with TED installed. (All connecting cables)
Digital multimeter (onboard with IMLSS)
TA1 Probe Kit.
General Mechanic Tool Kit.

SUPPLIES:

1. Clipboard 2. Paper 3. Leather Gloves 4. Vehicle chocks (4 each) 5. Pen

INDUCED FAULTS:

1. 3w107 x2 LEAD REMOVED FORM STARTER PILOT RELAY.
2. IGV RIGGING PIN REMOVED AT EMFS.

DETECTED FAILURES:

1. NO START UNTIL X2 IS INSTALLED.
2. PM II MISRIGGED IGV. FAULT WILL BE LEFT IN PLACE-PIN ORDERED.

TEDS Lane B
SCENARIO TWO

SITUATION:

You are assigned to 333rd Maintenance Company and are on Support Team B. You have reached A 34 (M1A1). The crew has reported that the engine is in protective mode. The vehicle has been prepared for you to troubleshoot.

TASK:

Initiate work order on TED. Diagnose faults using TED, operational checks, diagnostic procedures. Repair as possible and verify repairs. Determine parts required and post them to work order. Transmit the workorder to the shop office.

CONDITION:

In a motor pool environment, using IMLSS or laptop, SINCGARS radio, tools and supplies provided.

STANDARD:

Completely and correctly perform following:

1. Develop work order electronically.
2. Diagnose faults.
3. Repair and verify as possible.
4. Determine parts required.
5. Transmit work order.

***WARNING!!!**

Warning screens may come up telling you not to perform certain actions with the engine in the tank. For this scenario engine in tank is authorized provided that the following safety measures are taken.

1. Final drives disconnected.
2. Vehicle securely choked.
3. All unnecessary personnel cleared from area.
4. Turret hydraulic power disabled and zero pressured.

TEDS LANE B

SCENARIO TWO REQUIREMENTS

EQUIPMENT CONDITIONS:

Final Drives disconnected, vehicle choked.
Main gun elevated with engine access plate and doors open.
ABOB installed.

TOOLS:

Laptop or IMLSS with TED installed. (All connecting cables)
Digital multimeter (onboard with IMLSS)
TA1 Probe Kit.
General Mechanic Tool Kit.

SUPPLIES:

1. Clipboard 2. Paper 3. Leather Gloves 4. Vehicle chocks (4 each) 5. Pen

INDUCED FAULTS:

1. 3 W 105 P37 DISCONNECTED
2. FAULTY ROTOR TEMPERATURE (T1) SENSOR INSTALLED

DETECTED FAILURES:

1. PM II UNTIL P37 IS RECONNECTED.
2. PM IV - FAULTY ROTOR TEMPERATURE SENSOR. (FAULT WILL BE LEFT IN PLACE SENSOR ORDERED.

PALADIN TEST PLAN

V1
4 Feb 98

Hull

Scheduled maintenance:

Task one – Perform scheduled maintenance using the electronic test manual and digital multi-meter (PCMCIA version), while wearing the MARSS vest. Verbally record results on DA Form 2404.

1. Reference: TM 9-2350-314-20-1-1

Chapter 2

Table 2-1, item 18 (1) and (2) Perform visual inspection only and verbally record results on DA Form 2404.

Hull

Troubleshooting:

Task two – Perform unscheduled maintenance using the electronic technical manual and digital multi-meter (PCMCIA version), while wearing the MARSS vest. Verbally record results on DA Form 2404.

1. Reference: TM 9-2350-314-20-1-1

Chapter 3

Para 3-3 h (1) Generator. Perform test A, B, and C and verbally record results on DA Form 2404.

Para 3-3 k (20) Lights. Perform test A and verbally record results on DA Form 2404.

Para 3-3 f (4) Combat override switch. Perform test A and verbally record results on DA Form 2404.

Turret

Troubleshooting

2. Reference: TM 9-2350-314-20-2-1

Chapter 3

Para 3-3 Automatic Fire Control System (AFCS).

- a). Troubleshoot failure in communications Processor.
- b). Troubleshoot failure in ballistic computer/weapon controller.
- c). Troubleshoot failure in tube temperature sensor.

Verbally record results on DA Form 2404.

21 April 1998

MEMORANDUM FOR U.S. Army Combined arms Support Command (CASCOM), Directorate of Combat Developments for Ordnance, Fort Lee, VA 23801-1809

Subject: Integrated Maintenance and Logistics Soldier System (IMLSS) ACT II Program Data Collection Plan

1. References. Proposal, IMLSS ACT II Program, FY97.

2. Introduction.

2.1 Purpose. This ACT II data collection plan examines the concept of using a soldier-wearable, voice activated computer to assist in maintenance and repair of weapons systems. The IMLSS also has data storage capabilities and can transmit this data to a remote location.

2.2. Scope. This memorandum delineates the parameters and methodology for conducting the IMLSS data collection plan. Information from this operational demonstration will provide baseline data for system performance and operational utility. Results will also be used to: refine the existing system; and examine applying IMLSS to other combat/combat service support vehicles. As the TRADOC representative, the proponent is responsible for conducting the IMLSS operational demonstration to provide information that either supports or does not support further TRADOC investment.

2.3. System Description. The IMLSS is a developmental, wearable computer system that allows a maintainer access to its capabilities during maintenance operations. The system is designed to allow the maintainer "real time" and "hands-free" access to technical publications and diagnostic capabilities while actual performing maintenance or repairs, e.g., on an M1A1 tank engine. The IMLSS consists of a wearable computer configured in a vest worn by the maintainer. The IMLSS has two modes of data input; voice and manual ("mouse"). A heads-up display (HUD) shows technical data; wireless communications links the maintainer to a remote station and allows access to additional technical data.

2.4. Background. This is a US Army Combined Arms Support Command (CASCOM) effort funded through the Army ACT II program and was initiated in fiscal year 1997.

2.5. Key Milestones. The proposed IMLSS-ACT II data collection plan will be conducted from 9 to 20 March 1997 at the National Training Center (NTC), Fort Irwin, CA.

3. Analytic Approach.

3.1 Issues. The IMLSS data collection effort will provide operational data to determine if the system satisfies the operational issues (see below). The data collected will be used to write an Abbreviated Operational Assessment AOA) to support a TRADOC decision to continue investigation of the technology. Due to the abbreviated nature of this effort, there are no additional operational issues and criteria. The following are the IMLSS operational issues with supporting criteria.

DRAFT

3.2. The data collection effort will be conducted by representatives from DCD-Ordnance, TECO-Lee and the IMLSS contractor, Boeing Aerospace. The contractor will install, maintain, and gather all IMLSS technical data in a manner that is unobtrusive and will not interfere with or compromise the conduct of the using unit(s) mission. Data collection will consist of recorded observations of the system in use. These observations will consider the operational issues stated above and in the IMLSS Test Plan. Additionally, these observations will be supplemented by surveys (attached) administered to soldiers who will use the IMLSS during this abbreviated operational assessment (AOA). DCD-Ordnance, as the proponent, will also provide subject matter expert(s) for data collection. This data collection will be done in an unobtrusive manner that will not interfere with or compromise the conduct of the using unit(s) mission. TECO-Lee will train the data collectors in their responsibilities.

3.3. Data from observations and surveys will be entered into a database daily. This data will become the basis for the AOA. TECO-Lee will convene a data authentication group of IMLSS team members periodically throughout the demonstration and upon its conclusion.

4. Operational Issue #1. Does the Integrated Maintenance and Logistics Soldier System (IMLSS) improve the effectiveness of maintenance operations?

4.1 Criteria

- a. IMLSS software will build an effective work order that is compatible with the Army Standard Maintenance System (SAMS). The software will generate a file input for SAMS.
- b. Work order software will use voice control to minimize mouse and keyboard entries.
- c. ILMSS work order software will not increase work order preparation time compared to the current system.
- d. IMLSS will use existing Electronic Technical Manuals (ETM). IMLSS will provide equal readability of ETMs compared to current methods and computers.
- e. IMLSS will provide equal to or better use of the RPSTL in the ETMs.
- f. IMLSS will transfer files from one computer to another using wireless LAN and SINCGARS.
- g. IMLSS will remotely control diagnostic computers used for Turbine Engines and Paladin.
- h. IMLSS will provide a digital PC card multimeter that will provide equal or a better capability compared to the existing multimeter. ETM and digital multimeter software will run simultaneously so the maintainer can compare meter readings to specifications in the ETM.

DRAFT

- i. IMLSS will provide equal or greater speed (compared to current system) of diagnosis/troubleshooting while providing a hands-free capability and freedom of movement around the weapon system.

5. Operational Issue #2. Is the Integrated Maintenance and Logistics Soldier System (IMLSS) operationally suitable for maintenance operations?

- a. IMLSS will withstand maintenance inspection and diagnostics operations.
- b. IMLSS must be comfortable to use and wear.
- c. IMLSS will be as easy to use as a laptop computer.
- d. IMLSS must be safe to use and not introduce additional hazards.

6. Demonstration Concept. The IMLSS-ACT II data collection effort will be conducted at the National Training Center (NTC), Fort Irwin, CA by the IMLSS team in a non-interventive manner. Representative maintainers will use IMLSS to assist in maintenance and repair operations on the M1A1 tank (and its engine, once removed); the high mobility multipurpose wheeled vehicle (HMMWV) and M109A6 self-propelled howitzer. IMLSS data collection effort will be conducted during maintenance operations in garrison and field environments. The test unit is the XXX, Fort Irwin, CA. The XXX DS maintenance activity will operate the IMLSS in accordance with its specifications.

7. Demonstration Data Management. Data management functions are defined as training data collectors, providing the data collection instruments (surveys or forms) and validating the collected data. All data management functions will be the responsibility of TECO-Lee in coordination with the other team members. Throughout the operational demonstration and at its conclusion, the TECO-Lee Test and Evaluation Officer will supervise all data collection activities. Additionally, TECO-Lee will convene a data authentication group to validate collected data during the demonstration and upon its conclusion. This validated data will become the basis for the abbreviated operational assessment.

8. Demonstration Support Requirements. Temporary duty and travel costs for the TECO-LEE Test and Evaluation Officer will be required in the management of the data collection activities.

9. Point of Contact. The TECO-Lee Test and Evaluation Officer and point of contact for this data collection plan is Major Timothy Raney, raneyt@lee-dns1.army.mil, 804-734-0084, DSN 687-0084).

JAMES E. McGEE
LTC, QM
Chief, TECO-LEE

IMLSS Data Authentication Group Charter and Standard Operating Procedures

1. **References.** DA PAM 73-1, Test and Evaluation Policy, dated 27 February 1995.
2. **Purpose:** This document will provide the Integrated Maintenance and Logistics Soldier System (IMLSS) demonstration team members with information and guidance on the Data Authentication Group's (DAG) organization, responsibilities, and procedures.
3. **Mission.** The IMLSS DAG is an ad hoc group of independent experts assembled for assessing all observations, monitoring data reduction, quality control, the identification, investigation and analysis of anomalies in the IMLSS database. The ultimate goal of the DAG is to produce a validated database that accurately reflects IMLSS performance and capabilities during the 9-20 March 1998 operational demonstration at Fort Irwin, CA.
4. **Responsibilities of DAG Members:**
 - a.) Review all IMLSS database data submissions for accuracy.
 - b.) Identify, investigate and analyze IMLSS data anomalies.
 - c.) Determine if erroneous data should be eliminated from database.
 - d.) Determine if there are any inaccuracies or discrepancies in the IMLSS database.
 - e.) Investigate and analyze inaccuracies or discrepancies in the IMLSS database.
 - f.) Recommend changes or modification to correct and validate the database.
 - g.) Vote on any data modification recommendation that will validate submitted data.
5. **DAG Membership:**

The DAG will consist of representatives from the following organizations to execute the roles and responsibilities of authenticating data:

 - a.) US Army Operational Test and Evaluation Command (OPTEC), TECO-Lee.
 - b.) US Army Combined Arms Support Command (CASCOM), DCD-Ordnance.
 - c.) Fort Irwin Support Battalion (?)
6. **Responsibilities of DAG Members:**

OPTEC, TECO-Lee:

 - a.) Chairperson of the DAG sessions.
 - b.) Schedules and informs DAG members the date/time of DAG sessions to ensure 100% attendance and participation.
 - c.) Ensures the IMLSS data manager provides each DAG member (before meeting), with data submissions for review during the DAG session.
 - d.) Record and submit any database change to the IMLSS data manager.
 - e.) Cast the tie-breaker vote during DAG sessions.
 - f.) Notify database manager of any data modifications recommended and approved by the DAG.

6. Responsibilities of DAG Members (cont.):

DAG Members:

- a.) Review all IMLSS database data submissions for accuracy.
- b.) Identify, investigate and analyze IMLSS database anomalies.
- c.) Determine if erroneous data should be eliminated from database.
- d.) Determine if there are any inaccuracies or discrepancies in the database.
- e.) Vote on rejection, acceptance and/or modification of all data submitted for input into the IMLSS database.

7. Concept of Operations.

- a.) The TECO-LEE representative will schedule and chair DAG sessions with all members in attendance. Member absence from a DAG session will constitute approval of the DAG proceedings for that missed meeting.
- a.) Before each DAG session, the IMLSS data manager will provide DAG representatives with a copy of all data submissions for review. The DAG will review data submissions provided by the data manager for acceptance, inconsistencies and discrepancies. The DAG is responsible for verifying the test data is accurate and a true observation from the demonstration.
- b.) The DAG Chairman will hear and accept discussion of inaccuracies or discrepancies in the IMLSS database from DAG members. After a thorough discussion, the Chairman will take a vote on member recommendations. No less than three votes constitute a decision from the DAG. TECO-LEE representative will cast the tie breaker vote if required.
- c.) If there is an anomaly, DAG members will conduct a suitable discussion. If the anomaly is determined valid, the DAG will attribute it to doctrine, organizational structure, training, exercise constraints or other. All anomalies will require comments by DAG member(s). After the DAG makes a determination, the data manager will annotate the data file with this information and will file as an historical record. The automated database will also reflect the DAG decision.

8. Release of Data. DAG members or the IMLSS demonstration team will not release any observance, test data, or copies of any portion of the database in any form or provide these data items to any person, agency, or organization. Requests for data from any organization outside of OPTEC, will be referred in writing to the Commander of OPTEC, who has sole authority to release data or its emerging results.

DEMOGRAPHIC SURVEY

NAME: _____ NUMBER: _____

UNIT: _____

AGE: _____ HEIGHT: _____ WEIGHT: _____

TIME IN SERVICE:

YEARS: _____ MONTHS: _____

MOS: _____

TIME IN MOS:

YEARS: _____ MONTHS: _____

EXPERIENCE WITH M1: YES NO YEARS/MONTHS: _____

EXPERIENCE WITH TEDS: YES NO YEARS/MONTHS: _____

EXPERIENCE WITH PALADIN: YES NO YEARS/MONTHS: _____

EXPERIENCE WITH HMMWV: YES NO YEARS/MONTHS: _____

High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

Task: A

Task Title: Using the ETM as reference, go to table 2-1 and perform item number 2c.

PROCEDURE: Inspect for loose rivets, cracks, loose or missing bolts and general body damage.

NOT FULLY MISSION CAPABLE IF: Any body damage that would hinder vehicle operation.

IMLSS LANE

Task Instructions:

1. Identify the equipment you are inspecting.
2. Verbally record results.

Data Collector: _____

Operators _____ NUMBER — B

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE

Task Instructions:

1. Identify the equipment you are inspecting.
2. Verbally record results.

Data Collector: _____

Operators _____ NUMBER — B

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

- Task: B

Task Title: Using the ETM as reference, go to table 2-1 and perform item number 3e.

PROCEDURE: Disconnect the leads from each glow plug (para 3-38) and check for resistance between glow plug terminal and ground. Reading should be continuity.

NOT FULLY MISSION CAPABLE IF: Reading is not continuity.

#3 cyl only

IMLSS LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

Task: C

Task Title: Using ETM, go to table 2-1 and perform item 10a.

Procedures: Remove wheel and tire assembly (para 8-3). Check front and rear lower ball joint mounting. For M996, M997, M1042, M1037, M1097, and "A1" and "A2" series vehicles, tighten rear lower ball joint to lower control locknuts to 60 lb-ft (81 N.m) and front to 35 lb-ft (48 N.m). All other models, tighten front and rear lower ball joint to lower control arm locknuts to 35 lb-ft (48 N.m) and ensure cotter pin is present. Tighten ball joint slotted nut to 73 lb-ft (99 N.m) and ensure cotter pin is present.
Not Fully Mission Capable If: Capscrews or locknuts are finger or hand turnable.

USE Jack and make contact, remove cap screw

IMLSS LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

Task: D

Task Title: Using ETM as reference, go to table 2-1 and perform item 19a. *use wear bars*

Procedures: Follow **WARNINGS** and **NOTE**. Check tread depth of tires with ~~tire gauge~~. If tread depth is less than 2/32 in. (1.59 mm), replace tire in approximately 400 miles (644 km), bias tires will wear 1/32 in. (0.79 mm), radial tires will take approximately 1,300 miles (2092 km) to wear 1/32 in. (0.79 mm). If mission will require the vehicle to travel this distance within a month, replace tire if it measures 3/32 in. (2.38 mm).

Not Fully Mission Capable If: Tread depth is less than 2/32 in. (1.59 mm).

IMLSS LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

Task: E

Task Title: Using ETM as reference, go to table 2-1 and perform item 21c.

Procedures: Follow WARNINGS and NOTES. Check and record specific gravity of each cell.

Not Fully Mission Capable If: If cell is below 1.225 specific gravity.

*check voltage of ea
battery and both
combined*

IMLSS LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE

Task Instructions:

1. Verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
High Mobility Multi-Purpose Wheeled Vehicle

Date: _____

Task: F - *not performed - scratched*

Task Title: Using ETM as reference, go to electrical diagnostic flowchart and perform tasks 1 - D2, page 2-72 through 2-84

Procedures: Follow flowchart instructions.

Not Fully Mission Capable If: Follow flowchart instructions.

IMLSS LANE

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

Work Order Transmitted:

Finish Time _____

Start Time _____

Total Time _____

BASE LANE

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

Work Order Transmitted:

Finish Time _____

Start Time _____

Total Time _____

DATA COLLECTION FORM
Paladin (M109A6)

Date: _____

Task Two - Troubleshooting - Hull

Task: Perform scheduled maintenance using the electronic technical manual and digital multi-meter (PCMCIA version), while wearing the IMLSS vest.

Task Instructions: Verbally record results on DA Form 2404.

Data Collector: _____

Operators _____ NUMBER: k

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

Work Order Transmitted:

Finish Time _____

Start Time _____

Total Time _____

DATA COLLECTION FORM
Tank Engine Diagnostic System (TEDS)

Date: _____

Scenario One

Instructions: Follow instructions provided, note Warning Message

Procedures: Follow instructions provided..

Not Fully Mission Capable If: Follow instructions provided.

Task: Initiate work order on TED. Diagnose faults using TED, operational checks and diagnostic procedures. Repair as possible and verify repairs. Determine parts required and post them to work order. Transmit the work order to the shop office.

IMLSS LANE

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____ NUMBER H

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

BASE LANE (Laptop)

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____ NUMBER H

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

DATA COLLECTION FORM
Tank Engine Diagnostic System (TEDS)

Date: _____

- Scenario Two

Instructions: Follow instructions provided, note Warning Message

Procedures: Follow instructions provided..

Not Fully Mission Capable If: Follow instructions provided.

Task: Initiate work order on TED. Diagnose faults using TED, operational checks and diagnostic procedures. Repair as possible and verify repairs. Determine parts required and post them to work order. Transmit the work order to the shop office.

IMLSS LANE

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____ NUMBER _____ H

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

Work Order Transmitted:

Finish Time _____

Start Time _____

Total Time _____

BASE LANE (Laptop)

Task Instructions:

1. Using a digital multimeter (PCMCIA version, as necessary) and verbally record results.

Data Collector: _____

Operators _____ NUMBER _____ H

Vehicle Number: _____

Finish Time: _____

Start Time: _____

Total Time: _____

Did Operator Use Voice Control: Y N
(If no explain):

Faults Discovered:

Comments:

Survey Administered: Y N

Work Order Transmitted:

Finish Time _____

Start Time _____

Total Time _____

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not **OMIT** any items, please answer **ALL QUESTIONS**.

A. Comfort Features:	Not At All 0	Slightly 1	Somewhat 2	Moderately 3	Very Much 4	Extremely 5	Can't Say or Not Applicable ?
1. Could Be Put-on Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Could Be Removed Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Wearable System Fits Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was Comfortable To Wear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Was Not Too Tight.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was Not Too Loose.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Seemed Balanced On Body.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was Easily Adjustable.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Did Not Pinch or Dig-in.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Was Not Too Heavy.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Vented Heat Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Had Sufficient Pockets/Pouches.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Easily Used Closures, Buttons, and Snaps.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not **OMIT** any items, please answer **ALL QUESTIONS.**

B. Movement:

Not At All Slightly Somewhat Moderately Very Much Extremely Can't Say or
 Not Applicable

- | | | | | | | | |
|--------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 14. Would Allow Body To Bend | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 15. You Could Move Your Arms | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 16. You Could Grasp Things | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 17. Did Not Shift Around Too Much..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 18. Allowed You To Walk | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 19. Allowed You To Run | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 20. You Could Crawl Under Things | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 21. You Could Climb Over Things..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 22. You Could Move Around The Vehicle..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 23. Allow You Of Your Hands..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 24. Seeing Things Was Not A Problem..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 25. Did Not Lift-Up /Bind-Up..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not **OMIT** any items, please answer **ALL QUESTIONS.**

C. Operational Characteristics:

	<i>Not At All</i>	<i>Slightly</i>	<i>Somewhat</i>	<i>Moderately</i>	<i>Very Much</i>	<i>Extremely</i>	<i>Can't Say or Not Applicable</i>
26. System Easy To Operate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Quiet In Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Could Use Other Equipment While Wearing..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Allowed You To Hear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Did Not Impair Seeing.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Allowed You To Communicate In Noise.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Visual Display Clear & Distinct.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Had Good Display Resolution... ..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. Provided Information Required.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Software Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. Allowed Hands Free Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Input Devices Worked Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. Was Safe To Operate.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not **OMIT** any items, please answer **ALL QUESTIONS**.

C. Operational Characteristics Continued:

Not At All Slightly Somewhat Moderately Very Much Extremely Can't Say or Not Applicable

39. System Could Operate In:

39A.	Wet Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39B.	Cold Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39C.	Hot Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39D.	Dusty Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40.	Responsive Voice Control.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41.	Voice Control Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42.	Voice Control Fast.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D. Maintenance Functions:

43.	System Voice Can Control TEDS.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44.	Could Use TEDS RPSTL.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45.	Display Useful While Adjusting Engine.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46.	Useful For Making Adjustments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47.	Could Reconfigure For Other Jobs.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

D. Maintenance Functions Continued:

	Not At All 0	Slightly 1	Somewhat 2	Moderately 3	Very Much 4	Extremely 5	Can't Say or Not Applicable ?
48. Easy To Read/See Illustrations.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
49. Easy To Read Text.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
50. Part Ordering Effective.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51. Good For Troubleshooting:							
51A. Electrical Systems.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
51B. Mechanical Systems.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
52. System Faster Than Technical Manuals.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
53. Useful for Initial Inspections.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

E. Mission:

54. Useful For Garrison Operations.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
55. Useful For Field Operations.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

F. Personal Observations:

56. System Better Than:							
56A. Technical Manuals (Paper).....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

Tank Engine Diagnostic System (TEDS)

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

F. Personnel Observations Continued:

Not At All Slightly Somewhat Moderately Very Much Extremely Can't Say or
 Not Applicable

56B.	SPORT.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56C.	Laptop Computer.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57.	I Like The Design Of The System.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58.	System Designed Well For My Job/Tasks...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59.	System Would Be:							
60A.	Easy To Store.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60B.	Easy To Clean.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61.	Seemed Durable and Strong.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

62. Please list any other comments, clarifications, or recommendations below (use back side if more space is needed):

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 1 of 6

NUMBER: k

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

A. Comfort Features:

	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
	0	1	2	3	4	5	?
1. Could Be Put-on Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Could Be Removed Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Wearable System Fits Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was Comfortable To Wear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Was Not Too Tight.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was Not Too Loose.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Seemed Balanced On Body.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was Easily Adjustable.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Did Not Pinch or Dig-in.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Was Not Too Heavy.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Vented Heat Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Had Sufficient Pockets/Pouches.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Easily Used Closures, Buttons, and Snaps.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 2 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

B. Movement:

	Not At All 0	Slightly 1	Somewhat 2	Moderately 3	Very Much 4	Extremely 5	Can't Say or Not Applicable ?
14. Would Allow Body To Bend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. You Could Move Your Arms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. You Could Grasp Things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Did Not Shift Around Too Much.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Allowed You To Walk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Allowed You To Run	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. You Could Crawl Under Things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. You Could Climb Over Things.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. You Could Move Around The Vehicle.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Allow You ^{USE} Of Your Hands..... 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Seeing Things Was Not A Problem.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Did Not Lift-Up /Bind-Up.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 3 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

C. Operational Characteristics:

	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
	0	1	2	3	4	5	?
26. System Easy To Operate.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Quiet In Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Could Use Other Equipment While Wearing..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Allowed You To Hear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Did Not Impair Seeing.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Allowed You To Communicate In Noise.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Visual Display Clear & Distinct.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Had Good Display Resolution....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. Provided Information Required.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Software Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. Allowed Hands Free Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Input Devices Worked Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. Was Safe To Operate.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 4 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

C. Operational Characteristics Continued:

	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
	0	1	2	3	4	5	?
39. System Could Operate In:							
39A. Wet Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39B. Cold Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39C. Hot Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39D. Dusty Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40. Responsive Voice Control.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41. Voice Control Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42. Voice Control Fast.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D. Maintenance Functions:

43. System Can Control PALADINS IDRS*.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44. Can Voice Control all of IDRS.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45. Display Useful While Adjusting Engine.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46. Useful For Making Adjustments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47. Could Reconfigure For Other Jobs.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 5 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

D. Maintenance Functions Continued:

Not At All *Slightly* *Somewhat* *Moderately* *Very Much* *Extremely* *Can't Say or Not Applicable*
 0 1 2 3 4 5 ?

48. Easy To Read/See Illustrations..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

49. Easy To Read Text..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

50. Part Ordering Effective..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

51. Good For Troubleshooting:

51A. Electrical Systems..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

51B. Mechanical Systems..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

52. System Faster Than Technical Manuals..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

53. Useful for Initial Inspections..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

E. Mission:

54. Useful For Garrison Operations..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

55. Useful For Field Operations..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

F. Personal Observations:

56. System Better Than:

56A. Technical Manuals (Paper)..... ☐ ☐ ☐ ☐ ☐ ☐ ☐

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

PALADIN (M109A6)

Page 6 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

F. Personnel Observations Continued:

	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
	0	1	2	3	4	5	?
56B. SPORT.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56C. Laptop Computer.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57. I Like The Design Of The System.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58. System Designed Well For My Job/Tasks...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59. System Would Be:							
60A. Easy To Store.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60B. Easy To Clean.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61. Seemed Durable and Strong.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
62. IDRS Easier Than Current System.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

*IDRS = Integrated Diagnostic Repair System (Software)

62. Please list any other comments, clarifications, or recommendations below (use back side if more space is needed):

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 1 of 6

NUMBER B

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

A. Comfort Features:	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
1. Could Be Put-on Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Could Be Removed Quickly.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Wearable System Fits Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Was Comfortable To Wear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Was Not Too Tight.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Was Not Too Loose.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. Seemed Balanced On Body.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Was Easily Adjustable.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9. Did Not Pinch or Dig-in.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
10. Was Not Too Heavy.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
11. Vented Heat Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
12. Had Sufficient Pockets/Pouches.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
13. Easily Used Closures, Buttons, and Snaps.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

Task High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 2 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

B. Movement:	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
14. Would Allow Body To Bend	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
15. You Could Move Your Arms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
16. You Could Grasp Things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
17. Did Not Shift Around Too Much.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
18. Allowed You To Walk	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
19. Allowed You To Run	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
20. You Could Crawl Under Things	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
21. You Could Climb Over Things.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
22. You Could Move Around The Vehicle.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
23. Allow You ^{USE} Of Your Hands.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
24. Seeing Things Was Not A Problem.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
25. Did Not Lift-Up /Bind-Up.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 3 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

C. Operational Characteristics:	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
26. System Easy To Operate.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
27. Quiet In Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
28. Could Use Other Equipment While Wearing..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
29. Allowed You To Hear.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
30. Did Not Impair Seeing.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
31. Allowed You To Communicate In Noise.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
32. Visual Display Clear & Distinct.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
33. Had Good Display Resolution... ..	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
34. Provided Information Required.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
35. Software Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
36. Allowed Hands Free Operation.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
37. Input Devices Worked Well.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
38. Was Safe To Operate.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET
Integrated Maintenance Logistics Soldier System
High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 4 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer **ALL QUESTIONS**.

C. Operational Characteristics Continued:

*Can't Say or
Not Applicable*
Extremely
Very Much
Moderately
Somewhat
Slightly
Not At All

39. System Could Operate In:

39A.	Wet Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39B.	Cold Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39C.	Hot Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
39D.	Dusty Environment.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
40.	Responsive Voice Control.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
41.	Voice Control Easy To Use.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
42.	Voice Control Fast.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

D. Maintenance Functions:

43.	System Voice Can Control STE-ICE.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
44.	Could Use HMMWV RPSTL.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
45.	Display Useful While Adjusting Engine.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
46.	Useful For Making Adjustments.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
47.	Could Reconfigure For Other Jobs.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 5 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

D. Maintenance Functions Continued:

Not At All *Slightly* *Somewhat* *Moderately* *Very Much* *Extremely* *Can't Say or Not Applicable*

- | | | | | | | | |
|-----------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 48. Easy To Read/See Illustrations..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 49. Easy To Read Text..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 50. Part Ordering Effective..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 51. Good For Troubleshooting: | | | | | | | |
| 51A. Electrical Systems..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 51B. Mechanical Systems..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 52. System Faster Than Technical Manuals..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 53. Useful for Initial Inspections..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

E. Mission:

- | | | | | | | | |
|-----------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 54. Useful For Garrison Operations..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 55. Useful For Field Operations..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

F. Personal Observations:

56. System Better Than:

- | | | | | | | | |
|------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 56A. Technical Manuals (Paper)..... | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
|------------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|

HUMAN FACTOR DATA COLLECTION SHEET

Integrated Maintenance Logistics Soldier System

High Mobility Multi-Purpose Wheeled Vehicle (HMMWV)

Page 6 of 6

Name: _____ Date: _____ Lane: _____

Rate the equipment/system on each factor listed below. Circle each item
SEPARATELY. Do not OMIT any items, please answer ALL QUESTIONS.

F. Personnel Observations Continued:

	Not At All	Slightly	Somewhat	Moderately	Very Much	Extremely	Can't Say or Not Applicable
56B. SPORT.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
56C. Laptop Computer.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
57. I Like The Design Of The System.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
58. System Designed Well For My Job/Tasks...	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
59. System Would Be:							
60A. Easy To Store.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
60B. Easy To Clean.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
61. Seemed Durable and Strong.....	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

62. Please list any other comments, clarifications, or recommendations below (use back side if more space is needed):